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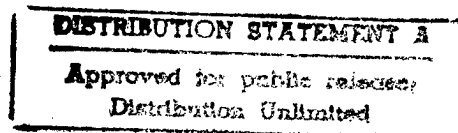
19 December 1985

# China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT--A5

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ENERGY: STATUS AND DEVELOPMENT--45**

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19 December 1985

# CHINA REPORT

## ECONOMIC AFFAIRS

### ENERGY: STATUS AND DEVELOPMENT--45

#### CONTENTS

#### NATIONAL POLICY

Energy Requirements, Strategy To Year 2000 and Beyond (Lu Yingzhong; ZHONGGUO KEJI LUNTAN [FORUM OF SCIENCE AND TECHNOLOGY IN CHINA], Sep 85).....	1
Two-Year Study Projects Energy Consumption Patterns by Year 2000 (XINHUA, 9 Nov 85).....	11
Energy Consumption Statistics for First Half of '85 Published (JINGJI RIBAO, 31 Aug 85).....	13
Hydro-Thermal-Nuclear Power Structure Proposed (Zheng Shaolin; FUJIAN LUNTAN No 8, 5 Aug 85).....	17
Preliminary Approach to Layout of Oil Refineries in China (Song Wucheng; NENG YUAN [JOURNAL OF ENERGY] No 4, Aug 85).....	23
Briefs Power Industry Manpower	28

#### POWER NETWORK

Protection of Systems Against Electromagnetic Pulse Discussed (Yue Baoliang; DIANLI JISHU [ELECTRIC POWER] No 8, 5 Aug 85).....	29
Accelerating Automation of Power Network Automation (Zhao Qingfu; DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER] No 4, Jul 85).....	32

Recap of Symposium on National Power Grid Dispatching Automation (Cai Yang, DIANLI XITONG DIZONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] No 5, Sep 85).....	42
Reports at Automated Power Grid Dispatching Symposium Excerpted (DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] No 5, Sep 85).....	44
Sichuan Adopts Variety of Measures To Resolve Energy Shortage (SICHUAN RIBAO, 1 Aug 85).....	52
Sichuan To Build Four Large Power Facilities (SICHUAN RIBAO, 5 Aug 85).....	54
Guangxi Power Industry Develops Rapidly (ZHONGGUO XINWEN SHE, 13 Nov 85).....	55
Zhejiang Diversifies Power Sources (XINHUA, 15 Nov 85).....	56
Shandong Makes Marked Progress in Power Industry (Shandong Provincial Service, 6 Nov 85).....	57
Beijing's Power Supply Said Vastly Improved (BEIJING RIBAO, 28 Sep 85).....	58
Briefs	
Guangxi Transmission Line Erected	60
Anhui Power Transmission	60
Zhejiang Power Generation	60
Shanxi 500 kV Line	60
Henan Develops Power Industry	61
Guangdong-Guangxi Power Network	61
Guangxi Power Development	61
Gezhouba-Shanghai 500 kV Line	61
Huainan-Shanghai 500 kV Line	61
Heilongjiang Power Construction	62

## HYDROPOWER

Economics of Hydropower Evaluated (SHUILI FADIAN [WATER POWER] No 9, 12 Sep 85).....	63
Proposed Cascade Development From Longyangxia to Liujiaxia (Shi Ruifang; SHUILI FADIAN [WATER POWER] No 8, 12 Aug 85).....	75
Construction of Longyangxia 'In Full Swing' (XINHUA, 15 Nov 85).....	81

Canada To Undertake Feasibility Study for Three Gorges Project (XINHUA, 8 Oct 85).....	82
Hunan Pushing Both Large- and Small-Scale Projects (XINHUA, 16 Oct 85).....	83
Fujian Small Hydropower Station Is Model of Efficiency (Xu Shicheng; FUJIAN RIBAO, 26 Aug 85).....	85
Briefs	
Baishan Update	87

#### THERMAL POWER

Plant To Be Built in Liaoning Will Be Nation's Largest (LIAONING RIBAO, 28 Oct 85).....	88
Construction of 1400 MW Dalian Plant Begins (LIAONING RIBAO, 11 Oct 85).....	89
Bidding Begins on Hebei Plant Equipment (XINHUA, 18 Nov 85).....	90
Briefs	
Huge Zhejiang Plant Approved	91
Hainan To Double Power Capacity	91
Big Shijiazhuang Plant Planned	91
Bids Invited For Coal-fired Plants	91

#### COAL

Output Increases During Sixth Five-Year Plan (ZHONGGUO XINWEN SHE, 11 Oct 85).....	93
Decline in Consumption Allows Greater Stockpiling (JINGJI RIBAO, 18 Nov 85).....	94
Now Miniscule, Coal Exports Could Take a Quantum Leap (Zhao Wei; JINGJI DAOBAO [ECONOMIC REPORTER] No 33, 19 Aug 85).....	96
Coal Exports To Grow During Seventh Five-Year Plan (RENMIN RIBAO (OVERSEAS EDITION), 14 Nov 85).....	100
Rapid Development of Northeast Coal Industry (JILIN RIBAO, 7 Aug 85).....	101
Bright Prospects for Northeast Coal Fields (Liu Xieyang; RENMIN RIBAO (OVERSEAS EDITION), 16 Oct 85).	102

Outstanding Results of Huainan Xie No 1 Coal Mine Described (RENMIN RIBAO, 26 Aug 85).....	104
Great Increase in Output of Coking Coal at Qitaihe Reported (HEILONGJIANG RIBAO, 1 Oct 85).....	106
Aerial Remote Sensing Uncovers New Reserves (XINHUA, 4 Nov 85).....	108
Anhui Overfulfills Energy Plan (Anhui Provincial Service, 31 Oct 85).....	109
Opinions Offered on Coal Field Geological Exploration (Wang Wenlong; ZHONGGUO DIZHI [CHINA GEOLOGY] No 6, 13 Jul 85).....	110
Briefs	
Hebei Overfulfills Plan	116
Shanxi Output Figures	116
Henan Anthracite Mine	116
New Jilin Coal Field	116
Coal Shipped From Shaanxi	117
Henan Overfulfills Quota	117
Huolinhe Strip Mine Expansion	117

#### OIL AND GAS

Reform Spurs Daqing's Development (Zhou Zhongxue; XINHUA Domestic Service, 29 Oct 85).....	118
Daqing Builds Third Underground Gas Storage Facility (HEILONGJIANG RIBAO, 2 Sep 85).....	119
Shandong Begins Double Pipeline Project To Meet Higher Output (ZHONGGUO XINWEN SHE, 18 Oct 85).....	120
Liaohé Crude Output Unaffected by Typhoon (LIAONING RIBAO, 24 Aug 85).....	121
Bright Prospects for Hainan's Petroleum Exploitation (Li Fu; HAINAN RIBAO, 23 Jul 85).....	122
Bohai Bay Venture With Japan (XINHUA, 31 Oct 85).....	125
Newly Discovered Reserves Enhance Prospects for Karamay (XINHUA RIBAO, 25 Sep 85).....	126
Petroleum, Geological Prospecting in Tarim Basin (XINHUA RIBAO, 27 Sep 85).....	127

## Briefs

New Liaoning Refinery	129
Shengli Increases Output	129
Maoming Export Base	129
Offshore Weather Service	129
Contract for Oil Search Awarded	130
Bohai Well Increases Production	130
Hubei Oil Refinery Develops	130
New Beibu Well	130
Daqing Reserves Revised Upward	131

## NUCLEAR POWER

Li Peng on Nuclear Power in Seventh Five-Year Plan (XINHUA, 4 Nov 85).....	132
---	-----

Role of Nuclear Power in Nation's Power Structure Reviewed (Peng Shilu; HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] No 6, 20 Jun 85).....	133
---	-----

## Briefs

Sunan Update	138
--------------	-----

## SUPPLEMENTAL SOURCES

Wind, Solar Power Development in Nei Monggol (XINHUA, 12 Oct 85).....	139
--	-----

Offshore Island To Become New Energy Pilot Base (XINHUA, 18 Oct 85).....	140
---	-----

Economic Feasibility of Biogas Construction in China (Huang Zhijie; NENG YUAN [JOURNAL OF ENERGY] No 4, Aug 85).....	141
--	-----

## Briefs

Gansu Solar Power Station	150
---------------------------	-----

## CONSERVATION

Conservation Effort by Industry Applauded (JINGJI RIBAO, 31 Aug 85).....	151
---	-----

Rural Areas Lag Behind Rest of Nation in Conservation (JINGJI RIBAO, 31 Aug 85).....	153
---	-----

## Briefs

1985 Conservation Target Exceeded	155
New Mixture Will Save Gasoline	155

## NATIONAL POLICY

### ENERGY REQUIREMENTS, STRATEGY TO YEAR 2000 AND BEYOND

Beijing ZHONGGUO KEJI LUNTAN [FORUM OF SCIENCE AND TECHNOLOGY IN CHINA] in Chinese Sep 85 pp 30-34

[Article by Lu Yingzhong [0712 2019 0022]: "Some Questions on Energy Strategies in Light of Predicted Energy Resource Demand in China"]

[Text] Energy is one of the primary material foundations of social development. China is engaged in socialist modernization and construction, which requires large amounts of energy. The seriousness of this issue has been acknowledged by everyone. How much energy, therefore, actually will be required to quadruple the total value of industrial and agricultural output by the end of this century? What strategic deployments must be adopted to guarantee energy supplies in China in the long term? These are major questions that concern national policy-making and they require multidisciplinary comprehensive research. This article will make a preliminary analysis and exploration of the results of projected energy demand in China made by the Nuclear Technology Research Institute of Qinghua University and the Technical Economics and Energy Systems Research Institute over the past several years.

#### I. Methods for Predicting China's Energy Demand in the Year 2000 and Preliminary Results

There are many methods for predicting future energy demand in China. The fact that different assumptions and prerequisites are used means that there are major differences in results, so it is difficult to make comparisons. Generally speaking, rougher methods require less statistical data, but they also can provide less information. Or, they may rely on exogenous data, which gives them rather low relative value. In view of the fact that China is a country where the planned economy is dominant, coordination, balance, and planning work between economic sectors are important measures used by the state to guide socioeconomic development. We should, therefore, compile a formal model for comprehensive energy resource--economic equilibrium centered on the dynamic input/output method permitted by existing data and use middle-term (15- to 20-year) forecasts of energy demand for research on macroeconomic development. The overall outline of this model is shown in Figure 1. The area within the dotted line is the part that already has been drawn and its socioeconomic policy-making uses endogenous inputs so that it conforms to the strategic goal of quadrupling the total value of industrial and agricultural

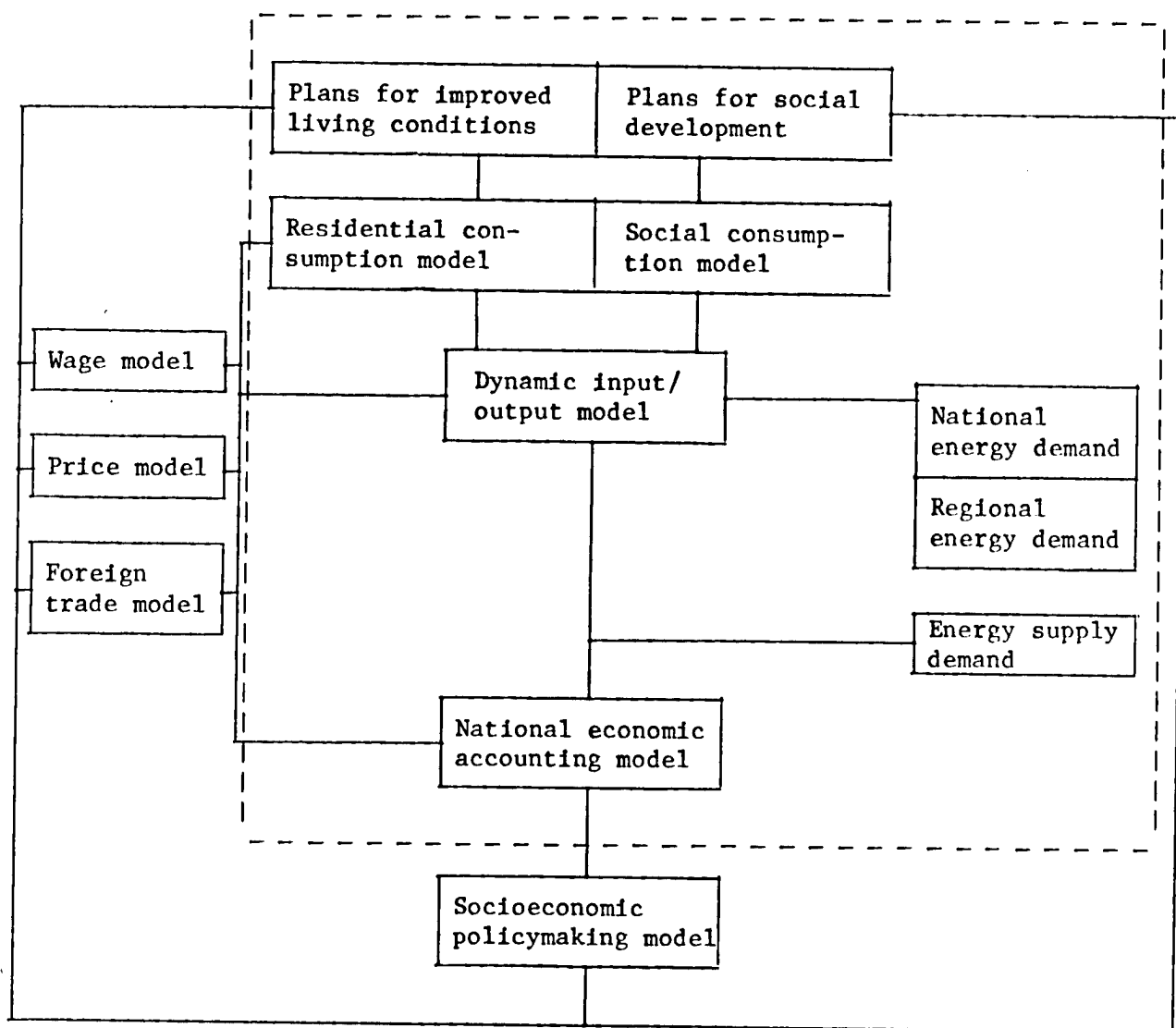


Figure 1. Diagram of a Comprehensive Model for Energy-Economic Balance (Area inside dotted lines shows already-compiled state energy resource models)

output by the year 2000. The three submodels for wages, prices, and foreign trade in the figure have not yet been developed and should be adapted to the new laws after future economic reforms. This model has the following characteristics:

1. It is a multiperiod dynamic equilibrium model and can be used a single time to derive a comprehensive balance for the scale of development each year for each economic sector for any year during the planning period. The developmental speed and investments required by each sector are endogenous to the model. This can guarantee mutually coordinated development in each sector of the economy over long periods.

2. It begins with social and household consumption demand, not with production capacity. This can reflect the goal-oriented nature and regularities of socialist commodity production in that the ultimate goal of commodity production is to satisfy the requirements of the people's (individuals and society as a whole) material and cultural lives. Ultimate consumption determines the scale of production.

3. The level of economic activity in each sector not only achieves multiperiod mutual balance between each production department in the dynamic input/output submodel but moreover, all types of economic information are included in the national economic accounting submodels to derive a mutual balance among all distribution channels. For this reason, the model embodies the superiority of the socialist planned economy in that economic activities are not carried out blindly but can be carried out in a coordinated manner throughout the planning period.

4. The model uses a socioeconomic policy-making submodel in the form of man-machine interaction, which is a reflection of the leadership system over economic work currently in effect in China. The policy decisions of leaders at all levels can be created and input into the model to examine their outcome. For this reason, the model can be used as a policy-making tool for leaders.

5. On the basis of achieving coordinated development of the national economy, this model can focus analysis and research on the energy question because it already has laid out two submodels for national and regional energy demand and energy supply, which can provide such important information as regional balance and systemization of supply and demand related to energy resources.

Based on the strategic goal of quadrupling the total value of industrial and agricultural output and bringing the people's standard of living up to a fairly comfortable level by the year 2000 as proposed by the CPC Central Committee, we employed various data available at the present time to make the following forecasts of economic development and energy demand in each sector up to the year 2000.

#### 1) Increased consumption and changes in its structure.

As was explained previously, the form of this model begins with a determination of consumption demand. With a projected 6.7 percent annual increase in total civilian consumption between now and the year 2000, the per capita growth rate would be 5 percent per year. The total amount of social consumption would grow by an annual rate of 7.5 percent. The results are shown in Table 1. The structure of consumption can be inferred on the basis of the total amount of consumption that was determined. The consumption structure according to sector shows that as per capita consumption levels increase, food products will account for a declining proportion while clothing, housing, travel, and other expenses will increase. This development conforms to regularities.

Table 1. Total Consumption and Its Distribution in the Years 1990 and 2000

Item	(Unit: billion yuan)		
	1980	1990	2000
Total consumption	250.8	475.3	935.0
Social consumption	27.5	57.5	121.6
Residential consumption	223.3	417.8	813.4

2) Growth in the value of output in each sector and changes in its structure.

The most obvious aspect when using the dynamic input/output method to calculate the value of output for each department and the structural changes in the value of industrial output is a rising proportion from the value of industrial output and a declining proportion of value from agricultural output. Estimates within the various industrial sectors are similar. There is an obvious increase in the proportion from light industry and decline in the proportion of metallurgical industries. There is basically no change, however, in the proportions of value of output from food products, textiles, sewn leather, and other typical light industry departments. Of course, the value of output in each department is determined by the structure of their products, which is hard to predict accurately with current data. Regularities in the changes show, however, that this is especially true of the ratio between light and heavy industries and their relative rates of development. The fact that inherent organic relationships exist between each of the departments also mean that they cannot be changed by the will of man.

3) Predicted growth in total demand for energy resources and changes in its structure.

If the results of the dynamic input/output model submodel are included in the energy consumption submodel, changes in energy consumption amounts and elementary structural changes in energy resources can be derived for each department. The data adopted concerning energy consumption per unit value of output took into consideration the potential for energy conservation in each department, which was inferred from existing energy conservation plans for each department. Failure to attain these plans completely would require an increase in the total amount of energy demand.

4) Predicted regional energy demand and changes in the direction of energy supply flows.

Total national energy demand based on the historical conditions and future development forecasts of each region for rational allocations can permit the derivation of forecasted regional energy demand (detailed information on this already has been reported). Predicted production in energy supply base areas and predicted demand for energy in each region make it possible to forecast energy resource flows between regions. Coal demand and supply indicates that

only a few provinces in China will have large amounts of coal that they can ship out by the year 2000 and that most of the other areas that formerly shipped out coal only will be basically self-sufficient. This means that the transportation problem for coal supplies in southeastern provinces will become increasingly serious and that more than 500 million tons of coal will be shipped over long distances.

An analysis of the preliminary results above shows that in order to guarantee the strategic goal of quadrupling the total value of [industrial and agricultural] output by the year 2000, the demand for energy will be 127.7 percent higher than in 1980, while a doubling [of value of output] would only require an increase of 27.7 percent. As mentioned above, this result includes all energy conservation measures currently proposed by all departments, and it takes into consideration changes in the coordination of economic structures. Moreover, it does not include exports of energy resources. It can be seen from this that difficult tasks remain if we are to solve all of the energy problems in China's socialist modernization and construction.

## II. Predicted Long-Term Energy Demand in China and Its Significance

China faces a serious challenge from energy resource problems if we are to quadruple the total value of industrial and agricultural output in China by the year 2000. What will the situation after 2000 be like? Should we give it further consideration at the present time? What effects will such longer-term predictions have on China's energy resource strategies? These are questions that deserve discussion below.

The long periods required to develop and construct a large-scale energy system (usually about 10 years or even longer) means that an even longer period (30 to 50 years) is needed for a new energy technology to move from manufacture to commercialization and extended utilization. For this reason, formulation of an energy strategy and evaluation of the rationality of an energy resource system require a forecast of development trends and problems that may appear over a period of 30 to 50 years. All nations in the world have come to realize the significance of this type of long-term prediction in recent years and they are doing a great deal of research work. The International Institute of Applied Systems Analysis (IIASA) is an international cooperative research organization that is engaged in just this type of long-term strategic research. They have used long-term forecasts to determine developmental trends and analyze the effects of current strategies for detailed research concerning global energy strategies.

In consideration of the long-term nature and difficulty of building socialism in China, a 50-year period should not be considered excessively long. The period between 1980 and 1990 is one of preparation for major economic development, and coordinated development at a sustained high rate only begins after 1990. The developmental momentum will just be unfolding in the year 2000, but per capita income will only be equivalent to \$1,000 at that time, far behind the developed nations. For this reason, it is thought that China will continue to maintain a high rate of development for a period of time after 2000 and that output will double every 10 years or so in order to catch up with most

developed countries as soon as possible and build China into a strong socialist nation. This should be the long-term strategic goal. For this reason, we have adopted the analytical logic of the IIASA to make the following forecasts of long-term energy demand. The results are shown in Table 2.

Table 2. A Long-Term Energy Forecast for China to the Year 2030

Item	Units	1980	1990	2000	2010	2020	2030
Gross domestic product	billion yuan	856.8	1,718.0	3,377.0	6,760.0	13,500.0	27,000.0
Per capita GDP	U.S.\$/person*	306	580	1,000	2,000	4,000	8,000
Average elasticity coefficient for the preceding 10 years			0.33	0.64	0.58	0.50	0.41
Total demand for energy**	billion tons of standard coal/year	.833	1.053	1.651	2.481	3.53	4.706
Average per capita energy consumption	tons of standard coal/person/year	0.833	1.0	1.37	2.06	2.93	3.91

\*Converted on the basis of foreign exchange rates.

\*\*Includes noncommodity energy resources of 230 million tons of standard coal/year.

We can see from Table 2 that there is a continual decrease in the elasticity coefficient after the year 2000. Total energy demand in China will reach the astonishing figure of 4.7 billion tons of standard coal in the year 2030 (about six times the 1980 amount), while per capita energy consumption will remain below average world levels (about 4 tons of standard coal/person/year).

The major significance of long-term forecasts of energy demand lies in their use to discover major problems in future energy systems development and to formulate corresponding strategies rich in farsight to deal with these problems to facilitate the achievement of long-term, stable, and sufficient energy supplies for China's economic construction.

### III. Several Important Questions in China's Energy Resources Strategy

An energy strategy that guarantees long-term socioeconomic development concerns a broad range of areas. We feel that there are three basic points:

#### 1. Formulation of rational social development goals and living patterns.

China is a socialist nation whose ultimate goal is communism. This means that the goal throughout the process of social development is to satisfy the

people's material and spiritual needs to the maximum possible extent. These needs grow continually, so guarantees of coordinated long-term stable growth should be considered in development strategies. This was our primary guiding ideology when we were formulating medium- and short-term models for a comprehensive energy-economic balance. When doing long-term forecasting and analysis, we looked from an even higher angle to determine whether or not policies are capable of guaranteeing the achievement of this goal.

To reach the above goal, the selection of rational patterns of living for the people has a decisive effect on policies for economic development (including energy). In communications, for example, completion of a goal of moving a similar number of passengers via public transportation consumes only one-sixth the energy of group buses and one-tenth that of automobiles. Public transportation is not as convenient and flexible as automobiles, however, so there should be some selection and comparison of communications questions in future living patterns, and we are speaking only from the perspective of transportation technologies. Urban planning has a great influence on communications problems. An enormous city region and overly decentralized residential points can increase the amount and distance of passenger movement by many times. Thus, the rationality of a population distribution is similar to the selection of transportation tools in that both are important factors that affect transportation capacity. The supply of heat for [city] residents is another example. The use of waste heat from power plants as a heat supply can increase overall thermal efficiency two or three-fold, but it requires the construction of a heat grid in the cities. Similar results could be obtained using electricity and heat pump systems, but it requires a large amount of additional equipment investments and operating costs. We must, therefore, choose between the two. Moreover, after basic living material needs are satisfied, most people will have even more urgent demand for spiritual life for certain other added material conditions. The two are completely different in terms of the energy required and consumption of other materials (including the consumption of energy), however. This means that comprehensive planning for social development goals and patterns of living are a basic starting point for formulation of an energy strategy. Building an energy conserving social structure and living models can make a basic reduction in the pressure on energy resources and actually is a drastic measure.

## 2. Rational utilization and protection of energy resources.

Our goal is to build communism. The goal of reaching a level of "rather well-off" by the year 2000 in China still is rather distant from our ideal world. If China can achieve stable development in a peaceful environment for the next 50 years, as illustrated in Table 1, then the value of output per capita will reach current levels in developed countries about that time (around the year 2030), but per capita energy consumption will be less than one-half that in the developed nations at the present time. This forecast was made by estimating the differences in lifestyles and improved rates of energy resource utilization. China has a large population, of course, so total energy output at that time is predicted to be between 4 and 5 billion tons of standard coal, which is equivalent to about one-half the total world energy production at the

present time. The long-term predicted demand for petroleum resources is that utilization of geological reserves will reach 89.797 billion tons in the year 2030. Long-term forecasts of electrical power structures indicate that hydropower output will reach 1 trillion kWh in 2030 (see Table 3). It can be seen that the potential of petroleum and hydropower will be nearly exhausted by around 2030-2050. The situation for coal will be slightly better, however, but if we wish to develop even more coal than the 600 billion tons in proven reserves at the present time, we must move into strata more than 1,000 meters deep or to Xinjiang, an area that is more than 3,000 km from the sea, which will extract substantial costs.

Table 3. A Long-Term Forecast of Electrical Power Structures

Item	1980	1990	2000	2010	2020	2030
Total annual electricity output (billion kWh)	300.6	600.0	1,200.0	2,150.0	3,500.0	5,180.0
By category:						
Coal-fired power (billion kWh)	189.0	460.8	880.8	1,300.0	1,730.0	1,784.0
(percent)	62.9	76.8	73.4	60.5	49.4	34.4
Hydroelectric power (billion kWh)	58.3	126.0	250.0	450.0	700.0	1,000.0
(percent)	19.4	21.0	20.8	20.9	20.0	19.3
Oil-fired power (billion kWh)	53.3	13.2	19.2	0	0	0
(percent)	17.7	2.2	1.6	0	0	0
Nuclear power (billion kWh)	0	0	50.0	400.0	1,070.0	2,400.0
(percent)	0	0	4.2	18.6	30.6	46.3
Energy consumption for electric power generation as a proportion of total energy consumption (percent)	20.46	26	26.3	28.6	30.6	32.3

Under such conditions, the development of new energy resources is only a supplementary measure as well as a substitution measure. Table 3 shows that it is possible that nuclear power may develop to the extent that it surpasses coal-fired power and hydropower in the year 2030 and truly becomes the largest pillar in electrical power systems. For this reason, the development of nuclear power is a long-term and extremely important strategy. This type of strategy also has great significance in the area of environmental protection. This sort of analysis indicates that China must be firm and unwavering in its determination to strengthen nuclear power.

For conventional energy resources, the key is to improve recovery rates and utilization rates. This is especially true of petroleum with its shortages,

and development of tertiary oil extraction and of unconventional resources is even more urgent.

In summary, looking from the perspective of protecting conventional energy resources, the development of new technologies to protect or replace conventional energy resources should be a primary direction for scientific and technical development of energy resources at the present time, and it also is an important policy.

### 3) Environmental and ecological protection and improvement.

China now has serious environmental pollution and destruction of ecological equilibrium. One of the primary factors is the energy resource system. Burning a large amount of coal pollutes the atmosphere while the use of a large amount of organic material destroys ecological cycles. The atmospheric pollution in cities now caused by the burning of coal has led to relatively serious acid rain problems at the present time. Table 4 shows the current pollution situation in some major cities. If we continue to rely on coal as the primary energy resource up to the year 2030, the amount consumed will be more than six times greater than at present, and the seriousness of the pollution at that time is hard to imagine. For this reason, we should strive as much as possible to increase the proportion of nuclear power in our forecasts. A reduction in the proportion of coal, however, requires the use of nuclear power to generate electricity, which will necessitate the utilization of large amounts of nuclear power for heat supplies. This is especially true of the nuclear power plants built near cities that practice joint supply of heat and electricity or simple supply of electricity. For this reason, the development of a "safe" and good second generation nuclear power plant is an important strategic measure. Of course, it is exactly for this reason that the amount of coal consumption forecast for the year 2030 will continue to grow to 2.1 billion tons of standard coal, which is about five times the amount in 1980. To reduce pollution, nuclear power should be used and coal converted to clean gas and liquid energy to form the so-called "clean energy" system. Although we never will be able to reduce the discharge [of pollutants] to zero, a substantial reduction of the discharge of pollutants will permit a fundamental improvement in the environment. Such a "clean energy" system that combines nuclear power and coal will become the backbone of China's energy resource system in the 21st century. This also is an important trend that has been seen in long-term forecasts and it is an extremely important aspect of China's energy strategies.

### Conclusions

Three key topics have been suggested for energy strategies in forecasts of long-term energy demand in China. They are the establishment of energy conserving socioeconomic systems and lifestyles, rational utilization and protection of energy resources, and protection and improvement of the environment and ecology. The formulation of an energy strategy on this basis not only can guarantee sufficient energy supplies for socialist construction in China but also will lead to continual improvements in environmental and ecological conditions and promote healthy development in socioeconomic life. This is an extremely important question for economic planning and decision-making at the present time.

Table 4. Average Pollutant Concentrations in the Major Cities of China

Pollutant	Units	Clean areas	Residential areas	Commercial areas	Industrial areas	Permitted levels
CO	g/m <sup>3</sup>	1.15-2.30	2.16-9.90	2.10-9.90	1.10-6.30	1.0
SO <sub>2</sub>	g/m <sup>3</sup>	0.01-0.31	0.07-1.83	0.03-0.54	0.02-1.52	0.15
NO <sub>2</sub>	g/m <sup>3</sup>	0.01-0.03	0.02-0.08	0.04-0.10	0.02-0.09	0.15
Benzo(2)-pyrene	g/100 m <sup>3</sup>	0.01-2.44	0.03-7.56	0.43-24.0	0.14-36.7	--
Atmospheric fly ash	g/m <sup>3</sup>	0.06-2.17	0.08-2.60	0.20-8.30	0.04-3.70	0.15
Sediments	tons/ 1,000 m <sup>2</sup> / month	3.2 -2.80	10.3-9.69	13.6-26.57	13.1-18.22	3.0

12539/9365

CSO: 4013/17

## NATIONAL POLICY

### TWO-YEAR STUDY PROJECTS ENERGY CONSUMPTION PATTERNS BY YEAR 2000

OW091222 Beijing XINHUA in English 1125 GMT 9 Nov 85

[Text] Beijing, 9 Nov (XINHUA)--A report on "China by 2000" calls for developing a consumption pattern and life style which consume less energy.

The report, carried by today's ECONOMIC DAILY, says an annual per capita output value of U.S.\$1,000 entails an annual per capita energy consumption of 1.5 tons of standard coal abroad, whereas China will only be able to supply 1 ton per capita annually by the year 2000.

The report is based on a 2-year research program backed by the State Council and the Chinese Academy of Social Sciences.

China's demand for energy will increase to 1.56-1.7 billion tons of standard coal by 2000, but output will amount to 1.3-1.48 billion tons, the report says.

The gap between demand and production will be 15-20 percent on average--a wider gap than at present.

As energy production centers move westward, east China will increasingly suffer shortages.

Shanxi and Inner Mongolia are expected to produce two-thirds of the newly increased coal output. Major petroleum producers will remain in east China, though offshore oil resources and those in west China are promising. More petroleum-processing facilities will be installed in central, south, and southwest China.

Thermal and hydroelectric power will be transmitted from north and central China to the east and northeast, where China's major industrial centers are located.

However, the development of the energy sector will be restricted by shortage of funds, backward technology, imbalance in the distribution of resources, pollution and other problems.

The report therefore suggests that efforts be directed toward the development of hydroelectric and nuclear power, and natural gas to reduce the proportion of coal-powered energy.

It also proposes more flexible policies to rationalize prices and pool funds from local administrations and enterprises.

In rural areas, planting trees and grass, promoting the use of fuel-saving ovens and developing small coal mines and hydroelectric power stations will be the solution to the energy shortage for China's 800 million peasants, according to the report.

/9604

CSO: 4010/11

## NATIONAL POLICY

### ENERGY CONSUMPTION STATISTICS FOR FIRST HALF OF '85 PUBLISHED

Beijing JINGJI RIBAO in Chinese 31 Aug 85 p 2

[Charts supplied by the Industrial and Communications Materials Department of the State Statistical Bureau]

[Text] Energy Consumption Per 10,000 Yuan of Output of Key Energy-Consuming Industrial Enterprises in the First Half of 1985

	<u>First half of 1985</u>	<u>Same period last year</u>	<u>Percentage Increase (+) Decrease (-)</u>
Total	25.24	26.61	-5
Metallurgy	18.20	18.78	-3.1
Power	63.73	63.91	-0.3
Coal	66.64	68.94	-3.3
Oil	34.02	35.34	-3.7
Chemical	24.77	26.28	-5.7
Machinery	7.63	9.88	-22.8
Building materials	30.91	31.98	-3.3
Light industry	7.85	8.36	-6.1
Textiles	4.47	4.60	-2.6
Other	9.4	10.12	-7.1

N.B. The comprehensive energy consumption of the key power, coal and petroleum enterprises includes the energy consumed in processing and transformation.

Energy Consumption for Products of Key Industrial and Transportation Enterprise Units in the First Half of 1985

<u>Item</u>	<u>Unit</u>	<u>Energy consumption per unit</u>	<u>Increase or decrease compared to last year (percent)</u>
1. Coal Industry:			
Coal used to produce raw coal	tons/ 10,000 tons	777	-0.26
Comprehensive power consumed for raw coal	kWh/ton	35.84	-1.27
2. Petroleum Industry:			
Crude oil used in oilfield	percentage	1.65	-0.04
Fuel consumed in crude oil processing	kg/ton	21.29	2.45
Electricity consumed in crude oil production	kg/ton	50.18	5.48
Electricity consumed in crude oil processing	kWh/ton	41.66	6.73
3. Power Industry:			
Standard tons of coal consumed in power generation	grams/kWh	396	-0.25
Percentage of power used by power plants	percent	6.40	0.10
4. Metallurgical Industry:			
Overall coke ratio	kg/ton	570	-0.35
Electric steel energy consumption	kWh/ton	624	0.48
Electrolytic aluminum energy consumption	kWh/ton	15,055	-3.15
Overall energy consumed for 1 ton of steel	standard tons of coal	1,296	-2.19
5. Chemical Industry:			
Coking coal and anthracite coal burned for synthetic ammonia (in medium-sized enterprises)	kg/ton	1,275	-0.62
Natural gas consumed for synthetic ammonia (in large enterprises)	million kilocalories/ton	9.69	0
Electricity consumed for synthetic ammonia (in large enterprises)	kWh/ton	12.29[sic]	0.65

[continued]

[continuation of table]

<u>Item</u>	<u>Unit</u>	<u>Energy consumption per unit</u>	<u>Increase or decrease compared to last year (percent)</u>
Electricity Consumed for synthetic ammonia (in medium enterprises)	kWh/ton	1,339[sic]	-2.12
6. Engineering Industry:			
Electricity consumed for electric steel smelting	kWh/ton	698	2.50
7. Building Materials Industry:			
Standard tons coal consumed for cement clinkers	kg/ton	199.62	-3.19
Standard tons of coal consumed for plate glass	kg/crate	30.47	-2.25
Overall electricity consumed for cement	kWh/ton	102.72	0.54
Electricity consumed for plate glass	kWh/crate	5.11	6.90
8. Textiles Industry:			
Standard tons coal consumed for viscose staple fiber	ton/ton	2.42	-13.26
Standard tons coal consumed for viscose long fiber	ton/ton	8.42	-13.19
Electricity consumed for cotton yarn	kWh/ton	1,930	0.67
Electricity consumed for cotton cloth	kWh/100 meters	22.60	1.09
Standard tons of coal consumed for dyed cotton	kg/100 meters	45.88	0.05
9. Light Industry:			
Electricity consumed for chemical wood pulp	kWh/ton	195	2.09
Electricity consumed for newspaper	kWh/ton	549	4.57
10. Railroads			
Coal consumed by steam locomotives	kg/10,000 ton-kilometers	108.1	0.56
Diesel consumed by diesel locomotives	" "	110.1	0.27

[continued]

[continuation of table]

<u>Item</u>	<u>Unit</u>	<u>Energy consumption per unit</u>	<u>Increase or decrease compared to last year (percent)</u>
11. Transportation			
Diesel consumed by ships (including ocean)	kg/1,000 converted ton nautical miles	8.6	2.33
Diesel consumed in Chang Jiang transport	" " "	7.07	-2.21

CSO: 4013/12

## NATIONAL POLICY

### HYDRO-THERMAL-NUCLEAR POWER STRUCTURE PROPOSED

Fuzhou FUJIAN LUNTAN in Chinese No 8, 5 Aug 85 pp 14-16

[Article by Zheng Shaolin [6774 4801 2651]: "Exploring the Establishment of a Joint Hydro-Thermal-Nuclear Electricity Source Structure"]

[Text] Electrical power that serves as a modern energy resource is an indispensable condition of modernization and construction. There now is a serious power shortage in Fujian that restricts economic development in our province. Accelerated development of the electric power industry is needed urgently to speed up the construction of strong and stable sources of electricity. Electric power projects require large investments and long construction times, and they have long-term effects, so a development strategy for the electric power industry also must be formulated scientifically. I feel that the development strategy for the electric power industry in Fujian to the end of this century should be accelerated development of hydropower and of coal-fired power along the coast because of their high economic results, active development of nuclear power, and great efforts to build an electricity source structure that combines hydropower, thermal power and nuclear power sources in a mutually complementary fashion. The reasons are as follows:

#### 1. Demand for Electricity Has Grown Rather Quickly in Fujian

Fujian's electric power industry has low levels and many shortcomings. Fujian had an installed generator capacity of 2.08 million kW in 1984, with power output of 6.8 billion kWh. The average per capita installed capacity is lower than the national level, the amount of electric power available per person being only 64 percent of the national average. Fujian's economy has developed rapidly in recent years and the demand for electricity has grown swiftly. The contradiction between supply and demand is becoming increasingly acute. There was a shortage of about 300 to 400 million kWh of electricity during the dry season in 1984, and it has been estimated that there also will be a shortage of 500 million kWh in 1985. According to incomplete statistics, the electricity shortage resulted in losses of 1 billion yuan in value of industrial output. The rate of growth has been slow, 4 to 5 percent, and the supply-demand shortage must be filled in quickly.

Moreover, Fujian has been attacked by the crashing waves of industrialization. The vast rural areas still consume large amounts of non-commodity energy

resources (about 40 percent of total energy consumption) at the present time. This implies that there will be further liberation of electric power utilization in these regions. Fujian must build supports for its industry; lay a good foundation for future development, bring about substantial development of rural and small town industries and move from low to high levels. The impetus of growth is even stronger in tertiary industries, and growth in electricity use in the people's lives now greatly exceeds that in the realm of production. Demand for electricity in Fujian must increase during this stage of development. The author uses an elasticity coefficient of 1.2 to use data on planned arrangements for development of the national economy in Fujian to make estimates, and summarizes them through comparison with data calculated using various methods in electric power departments. Predicted demand for electric power in Fujian is about 12.0 to 12.5 billion kWh in 1990, 21.0 billion kWh in 1995 and 34.0 billion kWh in the year 2000. To meet this demand for electricity, the total installed generator capacity must reach 3.4 million kW in 1990 and 9 million kW by the end of this century. Attainment of these indices would require that the amount of electricity available per capita in Fujian reach 1,077 kWh and that the installed capacity reach 0.285 kWh/person. This estimate is only equal to the national average and still is a very low level. We can do some crosswise comparisons to make this even clearer. The average amount of electricity available per capita in 1978 was 10,638 kWh in the United States, 4,180 kWh in the Soviet Union and 4,919 kWh in Japan. Among third world nations, the figure was 1,750 kWh in Korea and 1,112 kWh in Zambia. I feel that this sort of level must be reached. Otherwise, there will be even less reliable guarantees that China will achieve the goal of standing among the advanced ranks by the end of this century. If we consider the fact that Fujian only completed the installation of 2 million kW in installed generators during the 35 years since the founding of the nation and that total electricity output only reached 6.8 billion kWh and the fact that it will be necessary to add 1.4 million kW in installed capacity and 5 billion kWh in electricity output within the next 6 years as well as the installation of 5.6 million kWh in generator capacity and production of an additional 22.0 billion kWh during the 1990's, we can see that the tasks are enormous. Reliance only on hydropower and thermal power will be insufficient. We must develop nuclear power and work for combined hydro-thermal-nuclear sources.

## 2. Fujian Has Limited Hydropower Resources

Faced with the need for rapid development of electric power, there is no doubt that we should speed up development of hydropower resources in Fujian. This is especially true of hydropower with high economic results such as Mianhuatan, Jieman, the Shaxi He cascade, Jinxi cascade and other power stations. The development of these hydropower resources not only can provide Fujian with a great deal of electric power but also can improve water transport on the Min Jiang and provide many other benefits. We must not become intoxicated with the "abundance of hydropower resources" or let ourselves fall into such overly optimistic views as "no need to get it quickly since it is inexhaustible." Hydropower resources are renewable resources and can be called "inexhaustible" within an infinite time sequence. The amount of energy that can be supplied within a unit of time, however, is

limited. Fujian has about 7.05 million kW in developable hydropower resources. Installed hydropower capacity may reach 4.94 million kW by the end of this century, a development rate of 70 percent. Full development would result in farmland inundation losses of about 700,000 mu and require that a large population be resettled. Fujian is 80 percent mountains, 10 percent water and 10 percent farmland. Every inch is as valuable as gold. The losses would be too great. Full development also would be limited by the high railway standards. In reality, Fujian's hydropower resources cannot be used completely. The maximum limit will be approached at the end of the century when the hydropower "motherlode" with high economic results is almost completely developed.

Moreover, most hydroelectric power stations in Fujian (65 percent of the provincial total) were developed by using runoff and have poor regulation capabilities. Power must be reduced during dry periods, which is unsuited to carrying basic loads. There is no way that the advantages of hydropower can be utilized without the installation of a large amount of matching thermal power generators.

Under these conditions, besides great efforts to develop hydropower resources, we naturally also should strive to develop the two major electricity sources of thermal power and nuclear power.

### 3. The Long-term Benefits from Coal-fired Power Are Not Equal to Those from Nuclear Power

Coal-fired power has short construction times and a single generator capacity that is less than nuclear power. Full use of Fujian's port resources and accelerated construction of port power stations is completely necessary to meet the need for increased loads in the short and medium term, for improving electricity sources and for improving the layout of electricity sources. We cannot hope to adopt coal-fired power programs for all of the installed capacity apart from the 4.20 million kW from hydropower because total reliance in this manner would be restricted by communications and transportation conditions. A 4 million kW coal-fired power station requires the consumption of at least 13 million tons of raw coal. This would be an extremely enormous burden on Fujian's already severe shortages in shipping capacity. Nuclear power has an energy density that is incomparable with coal and there also is a possibility of permanent supplies. Nuclear power already has become a newly-erected pillar in the world's energy resources. An operational history covering more than 30 years has proven that nuclear power is technically reliable, operationally safe and economical to use and is especially advantageous in areas where coal and oil must be shipped in from long distances. The construction of two 900,000 kW nuclear power generators in Fujian could be substituted for 5.5 to 6 million tons of raw coal. This would alleviate greatly the pressure on coal transport and transform Fujian's power network into one of China's structurally rational, stable and reliable power grids. If we use only these economic indices to compare the good and bad of coal-fired power and nuclear power, the conclusion to be drawn is obvious.

1) Investments in coal-fired power are no cheaper than for nuclear power. Feasibility research on nuclear power stations in Fujian has shown that the rate of domestic equipment manufacture may reach 64 percent for nuclear power plants built during the mid 1990's. Calculated at a standard of a 1.80 million kW power station, the total investments for a nuclear power station would be 3.8 billion yuan. If 60 percent of the equipment used in coal-fired power plants was made in China, the investments for a power plant would be 2.25 billion yuan (the future would be 1.8 billion yuan if all the equipment were manufactured in China). Investments in coal-fired power stations, however, also should include investments in the matching coal shipment systems for the power plant. Shipping coal to Qinhuang Island would require a special flotilla composed of fifteen 25,000-ton class vessels, which would require investments of at least 500 million yuan. An additional 200 million yuan in investments would be needed for coal docks. This would raise the investment in coal-fired power to 3.0 billion yuan. Economic evaluation of an engineering project cannot look only at financial figures and use current prices to calculate costs. As mentioned above, coal-fired power takes up a great deal of valuable shipping capacity, which in Fujian is a "shortage resource." If we envisage Fujian having an externally oriented economic strategy, expanded foreign trade, readjustment in agricultural structures, development of industrial production...isn't it correct that this would be restricted by inadequate shipping capacity? The basic principles of technical economics tell us that correct economic evaluation of engineering projects and the cost of the "shortage resource" that would be taken up by the project must be calculated in terms of social costs (or shadow prices). The investments and costs calculated in this manner greatly exceed the related costs of coal shipments mentioned above.

In addition, a correct comparison of investment costs does not stop here. A common belief in the field of economics is that comprehensive economic comparisons also should include environmental losses. The SO<sub>2</sub> discharged by large coal-fired power plants is a major source of atmospheric pollution. If program comparability is satisfactory and we adopt similar environmental quality standards, investments in coal-fired power plants also should calculate the costs of the equipment required for sulfur removal. The additional sulfur-removing equipment would raise the construction costs of coal-fired power by 20 percent. It is apparent that an evaluation of major socio-economic systems shows that the theory that "coal-fired power is cheaper" should be re-estimated.

2) Electricity supply costs for nuclear power are lower than for coal-fired power. The advantages of nuclear power over coal-fired power are that supplies of nuclear fuels are reliable after operation is begun and that prices are low and stable. There are major variations in coal sources and coal prices. Research has shown that when the price of coal is greater than 95 yuan/ton, the costs of electricity supplied by nuclear power is far lower than coal-fired power. Moreover, price readjustments for raw coal are inevitable. The costs of electricity supplied by nuclear power are 0.015 yuan/kWh less than for coal-fired power when the new price of coal is used. This means that the annual profits from nuclear power would be 150 million yuan more than for coal-fired power! If we make economic evaluations

according to the correct methods and the use shadow prices (meaning the export FOB price for coal) to calculate the costs of coal-fired power, the superiority of nuclear power compared with coal-fired power is even more evident.

We can see from the analysis above that the selection of coal-fired or nuclear power actually involves a question of dealing correctly with the relationship between immediate and long-term benefits. Coal-fired power has shorter construction times and lower project investments. The technology is relatively simple and deals easily with contingencies. When the long-term benefits are considered, however, it is not as good as nuclear power. For this reason, besides striving to develop coal-fired power to meet short-term demand, we also should develop nuclear power.

#### 4. Fujian Has Excellent Conditions for Building Nuclear Power Stations

Fujian has a long coastline and many harbors, so it is easy to ship in large nuclear power equipment. Moreover, the seawater can be used as cooling water, so water supplies are convenient. Most of Fujian's coastline meets the earthquake intensity requirements for station construction and it is easy to find plant sites with low population densities. This is something that other nuclear power station and plant sites in China (like southern Jiangsu and Liaoning) cannot compare with. The coastal regions were the first in Fujian to be opened up to the outside. The economy is developed, electricity loads are concentrated and the construction of nuclear power stations also is very rational from the perspective of the layout of electricity sources.

People think about the enormous costs of building nuclear power stations and especially about the large amounts of hard-to-repay foreign exchange that will be needed. In reality, calculations indicate that adoption of a program in which 64 percent of the equipment is produced in China would require about \$450 million in foreign exchange. The total amount of foreign exchange needed including repayment of interest would be \$820 million, so the amount of foreign exchange used would be only 55 percent of the amount at the Shuikou power station (the amount of electricity it supplies would be double that of Shuikou), so it is not so enormous. If we only have a positive attitude and open up routes, foreign exchange collection and repayment could be solved.

It is easy to point out that the construction costs of nuclear power stations abroad have increased in recent years. Among the main reasons are longer construction times and higher interest rates. The benefits of coal-fired power are determined mostly by variations in the price of coal. The construction cost of nuclear power stations can be reduced greatly through meticulous planning and scientific construction.

There also are those who fear that the small capacity of Fujian's power network could not handle enormous nuclear power generators. This actually is an unnecessary concern. Continual expansion of power grids is an inevitable trend in the development of electric power systems in the world today because this is needed to achieve maximum economic efficiency in the

electric power industry. The East China Grid depends mainly on thermal power and is in urgent need of hydropower and there is a great amount of seasonal electricity for which there is no outlet. There is hope that the Fujian and East China Grids can be joined for mutual complementation and benefits, with both profiting. When nuclear power is built, the Fujian electric power system already will have become a junior system of the East China electric power system, so there will be no question of excessive single generator capacity. Some people have suggested that, when the **Shaxikou power station** goes into operation and is joined with the East China Grid, construction of a 370 kilometer long single-return 500 kV line will permit the transmission of 2.0 billion kWh in seasonal electric power to east China 5 years after its completion. The entire 100 million yuan in investments can be recovered within 5 years. If a dual-return line goes into operation at the same time that the Shuikou power station is completed, it could sell 2.5 billion kWh each year in seasonal electric power to east China by 1995, and it is possible that the annual income from selling the power may reach 150 million yuan. This sort of program could obtain benefits for many sides and also could lay a foundation for the construction of nuclear power, so it deserves consideration.

It is not hard to imagine that nuclear power will become an extremely important pillar in Fujian's energy resources. The construction of a new electric power structure that combines hydro, thermal and nuclear sources in a mutually complementary fashion is an inevitable development in Fujian's electric power industry.

12539/12899  
CSO: 4013/22

## NATIONAL POLICY

### PRELIMINARY APPROACH TO LAYOUT OF OIL REFINERIES IN CHINA

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 4, Aug 85 pp 16-17, 15

[Article by Song Wucheng [1345 2976 2052]: "A Brief Discussion of Problems in the Layout of China's Oil Refining Industry"]

[Text] China now has 34 large- and medium-sized oil refineries with an annual crude oil processing capacity of more than 500,000 tons. Preliminary crude oil processing capacity basically approximates crude oil output in China, both of them exceeding 100 million tons. We now can produce more than 670 different petroleum products and product quality basically meets state standards. Demand in national defense and in the various departments of the national economy basically is satisfied and a certain amount of petroleum products can be provided for export each year.

Attention gradually is being given to the layout of oil refineries in terms of matching up petroleum production, transport and sale. Some oil refineries have been built in regions that consume petroleum products and crude oil shipping has focused mainly on pipeline and water transport. With the exception of the fact that there are few oil refineries in the southwest, all the major regions have oil refineries at different scales and the situation in the past where oil refineries were concentrated mainly near oil fields and along coastal regions is changing gradually. Irrational phenomena still can be found in the layout of refineries, however. The main problems from the perspective of the major regions of China are that there is too much in the northeast and too little in the southwest and that it is concentrated along rivers and is very large in Beijing. This layout has two negative results: 1) It takes up a great deal of rail shipping capacity; and 2) Long-distance shipment of finished oil causes greater loss and wastes energy than does the shipment of crude oil. Statistics for 1982 show that 36 percent of China's oil refining capacity is concentrated in the northeast, while only 0.01 percent is in the southwest (see Table 1). The situation was roughly the same in 1983 and 1984.

The northeast has many refineries and processes a great deal of crude oil, accounting for 37.8 percent of the amount of crude oil processed in China. This region burns a lot of oil, so it accounts for more than 40 percent of fuel oil output in China (see Table 2). It is a compressed oil-burning region. The finished oil produced in the northeast is not completely used up in the region, so a great deal of it must be shipped to other areas. According to

Table 1. Distribution of Crude Oil Preliminary Processing Capacity in Oil Refineries in Each of the Major Regions in China, 1982

(units: 10,000 tons)

	China	North-east	North	North-east	East	South-central	South-west
Crude oil preliminary processing capacity	9913	3623	1170	798	2537	1775	10
Percent of national total	100	36.5	11.8	8.1	25.6	17.9	0.1

statistics on the production-sales balance for gasoline, coal, diesel, lubricating oil and other primary petroleum products, output in the northeast region is 4.5 times as large as demand within the region. The northeast has been shipping out a great deal of finished oil for years, reaching 9.82 million tons in 1982 (see Table 3). This uses up a large amount of rail transport, as much as 7.6 billion ton/kilometers each year. The northeast region and Guangdong regions have energy shortages. It has been estimated that the rail transport capacity that would be released by a decrease of 4 million tons in shipments of finished oil from the northeast into Shanhaiguan would allow an additional 5 to 6 million tons of coal to be shipped to the northeast. Guangdong and other areas. This would increase the value of output in these regions by 4.7 billion yuan, including about 3.5 billion yuan in increased output in the northeast. Under such conditions, the question of building additional oil refineries or expanding existing ones in the northeast, whether along the coast or in the interior, should weigh the advantages and disadvantages of doing so. China has 14 coastal cities that have been opened up to the outside and many of the cities or nearby areas already have large oil refineries. Dalian, for example, has the large No 7 Petroleum Refinery. The petroleum products produced in this refinery are fully capable of meeting demand in the Luda region. The construction of a new oil refinery at Dalian would further expand the contradiction between output and demand in the northeast.

Table 2. Distribution of Crude Oil Processing and Fuel Oil Output in the PRC (units: 10,000 tons)

	China	North-east	North	North-west	East	South-central	South-west
Crude oil processed	7206.5	2723.6	873.2	541.0	1766.3	1293.5	8.9
Percent of national total	100	37.8	12.1	7.5	24.5	17.9	0.1
Fuel oil output	2609.6	1067.9	368.5	102.7	638.8	429.6	2.1
Percent of national total	100	40.9	14.1	3.9	24.5	16.5	0.1

Table 3. The Production and Sales Situation for Gasoline, Kerosene, Diesel and Lubricating Oil for Each Major Region in China, 1982

(units: 10,000 tons)

	China	North-east	North	North-west	East	South-central	South-west	First-level stations
Total output	3332.3	1262	291.45	339.55	823.5	610.30	5.5	
Percent of national total	100	37.9	8.7	10.2	24.7	18.3	0.2	
Total amount of sales	2531.66	279.96	337.59	222.74	665.93	533.04	216.2	276.2
Percent of national total	100	11.06	13.33	8.8	26.30	21.05	8.54	10.91
Amount shipped out		982.04	-46.14	116.81	157.57	77.26	-210.7	

Six modern large oil refineries have been built or expanded along the banks of the Chang Jiang in the past decade or so. This was an inevitable trend in the development of the oil refining industry in China. One of the main goals was to make full use of the Chang Jiang's natural shipping route to develop water transport and save the enormous investments for construction of railways or oil transmission pipelines. The costs of water transport are very low. After the oil refineries were built, however, transportation systems were not matched up with them, and there is no railway shipping trunk running perpendicular to the Chang Jiang. There was no way that the finished oil from the newly-built oil refineries could be shipped out quickly and the transportation problems remain unsolved.

The largest oil refinery in China, the Dongfanghong [East Is Red] Oil Refinery, was completed in Beijing in 1970. The petroleum products made at this oil refinery greatly exceed actual demand in the Beijing region. The result is that a great deal of primary energy resources (crude oil) must be shipped into Beijing and a large amount of secondary energy resources (finished oil) must be shipped out, which is an irrational phenomenon. This has a great influence on the passage capacity of the Beijing region's railway hub. Another modern large oil refinery was completed at Shijiazhuang in Hebei in 1983. It has a crude oil processing capacity of 2.50 million tons, which has exacerbated the contradiction between output and sales in this region (oil refining capacity in this region greatly exceeds demand because of the large oil refineries in Beijing and Tianjin municipalities and Shandong Province). There were two sources of such competition to build refineries: 1) The price of crude oil was too low, oil refining enterprises could make large profits and the provinces and municipalities pursued their own interests; and 2) Policymaking organs pursued the local interests of their region, or there was insufficient debate concerning the feasibility of refinery layouts. The result has been that regions have gained local benefits while the state has borne a heavy burden and suffered enormous economic losses.

Based on the principle that oil refineries should be built in areas that consume oil products, it is urgent that new oil refineries be built in Yunnan, Guizhou, and Sichuan in southwestern China. The south-central and east regions also can give consideration to the deployment of additional refineries. Examples include consideration of the production of high-quality, refined and top-notch petroleum products for export to open up international markets and engage in competition. Moreover, the favorable water transport conditions of the coastal regions would make construction of two new refineries at Lianyungang [Jiangsu Province] and Shantou [Guangdong Province] most appropriate. The reason is that Lianyungang is located at the starting point of the Shaanxi-Haizhou Railroad and has no refinery at the present time. Water and land communications both are convenient and the transport conditions for oil products are good. Even more important is that Lianyungang is a gateway to northern Jiangsu, central Hebei, northern Anhui and northeastern Henan. There are rather broad domestic markets in these areas and highway transport is developed there. There is very great potential for agricultural and industrial development. Northern Jiangsu is a nationally important commodity grain base area that requires large amounts of chemical fertilizer, especially urea. There also are rather good sales avenues for other light and chemical industry products. Moreover, Lianyungang is located near the Subei and Zhongyuan Oil-fields, so it is both a crude oil producing region and an oil product marketing and consumption region. In this sense, the economic benefits from building a new refinery at Lianyungang are much superior to those for any other coastal city. The southeastern coastal city of Xiantou in Guangdong and other areas should increase the deployment of refineries as appropriate. They can refine and sell Nanhai [South China Sea] crude oil when the Nanhai Oilfield goes into production. This not only could satisfy some of the demand for oil products in southern China but also could alleviate certain shortage situations through the shipment of petroleum products from north to south.

At present, the fact that some crude oil is exported or burned directly as fuel means that only about 70 million tons of crude oil actually is processed in Chinese refineries. The highest figure, 77 million tons, was in 1983. This means that China as a whole has inadequate supplies of crude oil and surplus oil refining capacity, the operational rate being only 70 percent. This is one of the main reasons for the high energy consumption, high costs and low economic results of refined oil products in China. In recent years, experts in related areas have called again for readjustment of the amount of crude oil processing in China to reduce crude oil supplies in the northeast and increase them in the east and south-central regions. This problem still has not been solved. China's crude oil output has continued to grow each year, however. The Dalian No 7 Petroleum Refinery, one of the main refineries in the northeast, can consider technical transformation or technology imports focused on high-quality, refined and top-notch petroleum products with a concentration on export petroleum products. In this way it could achieve the goal of readjusting the amount of crude oil processed without additional refineries while improving economic results and exporting more for foreign exchange.

The deployment of oil refineries not only involves questions of a rational match-up of petroleum product output, supply and marketing, but also determines the layout of the organic chemical industry. Oil refineries provide raw

materials directly for synthetic plastics, synthetic fibers, synthetic rubber, synthetic ammonia and other organic chemical industries. For this reason, the layout of oil refineries should give consideration to developmental trends in the petroleum chemical industry. More than 95 percent of the world's organic chemical products now come from petroleum. Technical maturity and coordination in the petroleum chemical industry also has conserved a great deal on investments, and the forecast is that the coal chemical industry will not replace it for a rather long time to come. The petroleum chemical industry in China still is in the state of major development and China has rather abundant petroleum resources, sixth worldwide, so it has the material foundation for development of the petroleum chemical industry.

Oil refineries may pollute the water and air to different degrees, so the layout of oil refineries also should pay attention to environmental protection.

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CSO: 4013/187

## NATIONAL POLICY

### BRIEFS

POWER INDUSTRY MANPOWER--There are nearly 300,000 survey design, construction, and equipment-installing personnel working full time under the Ministry of Water Resources and Electric Power. They are capable of completing 50 million cubic meters of earthwork and 10 million cubic meters of concrete work, and installing over 3 million kilowatts of generating units annually. Since the founding of the country, this contingent of personnel, specialized in water resources and electric power, has successfully completed a number of important projects. With the recent completion and operation of a number of large and medium-sized hydroelectric power plants, the installed capacity of all hydroelectric power plants in the country has increased to 25.6 million kilowatts, with 86.8 billion kWh generating power. /Summary/ /Beijing Domestic Service in Mandarin  
1100 GMT 24 Sep 85 OW/ 12228

CSO: 4013/30

## POWER NETWORK

### PROTECTION OF SYSTEMS AGAINST ELECTROMAGNETIC PULSE DISCUSSED

Beijing DIANLI JISHU [ELECTRIC POWER] in Chinese No 8, 5 Aug 85 pp 72-73

[Article by Yue Baoliang [1471 0202 5328], Jilin Province Electric Power Survey and Design Institute: "Protection of Electric Power Systems Against Electromagnetic Pulse"]

[Text] In the past, when planning the joint development of electric power and electronic communications, we concentrated primarily on protecting communications from being influenced by electric power lines, i.e., electromagnetic compatibility (EMC). Since the 1970's, with U.S.-Soviet competition in the development of nuclear weapons, a new nuclear weapon, the electromagnetic pulse (EMP) has been threatening power line safety, and in the future we will have to intensify research on protecting the electrical systems themselves.

#### What Is Electromagnetic Pulse?

Initially, in a nuclear explosion in the upper atmosphere, the extremely high-energy gamma rays strike the molecules of the surrounding air and ionize them, producing electrons with an energy of about a million volts that fly away from the center of the explosion at the speed of light, thus resulting in rapid separation of positive and negative charges and producing a very intense electrical field (Figure 1). At the same time, this cloud of electrons flying away from the center of the explosion produces a strong magnetic field, just as electrons flowing in a wire do. Because of the nonuniform density of the upper atmosphere, the charge distribution is nonuniform and the explosion source immediately emits an electromagnetic pulse, acting like a radio broadcasting antenna (Figure 2). The rise time of the electromagnetic pulse is extremely short and is determined by the rise time of the gamma ray pulse, reaching a peak of 50 kV/m in about 0.01 microseconds; the pulse shape is shown in Figure 3.

The range of coverage of electromagnetic pulses produced by nuclear tests in the upper atmosphere can exceed 1,000 km, as shown in Figure 4, where  $H = 400$  km and  $S = 1,800$  km. In addition, the pulse is highly destructive.

In 1958 the United States carried out a nuclear test in the upper atmosphere above the South Atlantic and discovered that distant electronic **equipment** had been damaged. In 1962 the United States performed a nuclear test at an

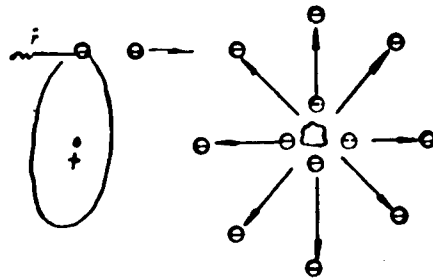


Figure 1. Strong Electric Field Produced by Nuclear Explosion in the Upper Atmosphere

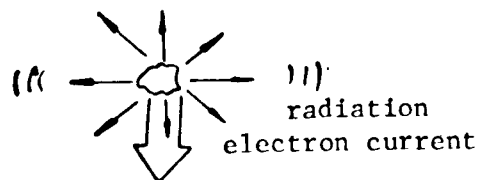


Figure 2. Nuclear Explosion Radiates EMP

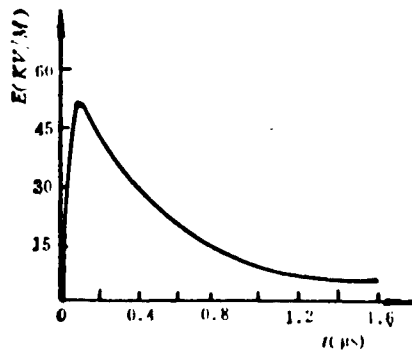


Figure 3. Pulse Waveform

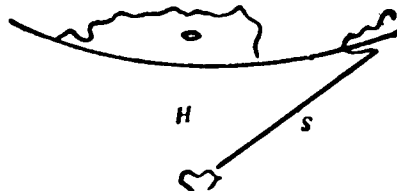


Figure 4. Area of Coverage

altitude of 400 km over Johnston Island in the Pacific, as a result of which more than 300 streetlights were burned out in the Hawaiian Islands, over 1,300 km from the blast, blacking out cities and setting off emergency alarms. Transformers burned out, and the lightning arrestors on high voltage lines actuated.

Electric transmission lines, electric cable circuits, the wires to automatic installations, and communications circuits are all affected by electromagnetic radiation. It is calculated that the open-circuit voltage of a power line 30 km long and 10 m high is 1,000 kV, while the inductive voltage of an antenna 1 mile long is 20 kV; although the duration is only about 10 microseconds, such a field intensity and such an extensive area of coverage should produce breakdowns of insulation in equipment over a wide area, malfunctioning of automatic devices, interruption of communications, or even system disintegration. EMP warheads have already become a strategic weapon especially intended to destroy power systems, electronic communications, and command and control systems.

Where there is a sword there is always a shield, and, like lightning, electromagnetic pulses can be defended against; the technology is called "nuclear hardening."

There are six main protective measures: grounding, filtering, guarding, avoidance, shielding and strengthening. Specifically, they involve the following:

- (1) development and use of high-voltage lightning arrestors of the requisite speed;
- (2) use of low-pass filters to stop high-frequency surges;
- (3) upgrading the insulation of corner poles and end poles;
- (4) use of optical cable communications;
- (5) shielded housings for equipment and shielded lead-in wires;
- (6) keeping vacuum-tube automatic device circuits on some generating units in power plants (because tubes are 10,000 times more resistant to EMP than semiconductors are).

Because of the immense damage that EMP can do to far-off power systems and communications systems, the United States has already expended a great deal of manpower and resources in establishing an EMP society and investigating the protection of entire power and communications systems; and the Soviet Union's most advanced MIG aircraft still uses vacuum tubes. These facts are worth serious consideration. In China, EMP is also an important topic which urgently requires investigation.

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CSO: 4013/179

## POWER NETWORK

### ACCELERATING AUTOMATION OF POWER NETWORK AUTOMATION

Nanjing DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER] in Chinese  
Vol 9, No 4, Jul 85 pp 3-8

[Article by Zhao Qingfu [6392 1987 1133] , Vice Minister Ministry of Water Resources of Electric Power: "Speeding Up Construction Work for Implementation of Power Network Dispatch Automation--A Speech at the National Power Network Dispatch Automation Planning Conference"]

[Text] Comrades:

The State Council's Electronics Promotion Leadership Group has paid extremely close attention to work done by the Ministry of Water Resources and Electric Power in the area of power network dispatch automation. They not only have included work in this area in key state computer application projects but they also have established a specialized ministerial group for a "power grid monitoring and regulation modernization management system" to lead power grid dispatch automation work in the ministry. One of the focuses of our work in the short term is to compile the "Outline Regulations for National Power Network Dispatch Automation," to determine the direction of development and related technical policies and to clarify the goals of struggle in order to accelerate the implementation of work to build power grid dispatch automation.

This was the first such conference, and it was attended by leading comrades from management, production, design, scientific research, manufacturing and other units in China's electrical power system as well as from units outside the ministry. Moreover, responsible comrades from the State Council's Electronics Promotion Leadership Group office also provided personal direction for the conference. The main content of the conference was to ask everyone to examine the "Outline Regulations for National Power Network Dispatch Automation" (Discussion Outline) to continually enrich and perfect them to guide the development of power grid dispatch automation work. The meeting fully encouraged democracy, speaking freely and drawing on collective wisdom and absorbing useful ideas. The discussions strove to unify ideas and paces.

I would like to discuss three questions here today: 1) The urgent need for power grid dispatch automation to develop electric power; 2) Striving to change the backward situation in China's power grid dispatch automation as

quickly as possible; and 3) Some views concerning accelerated construction of power grid dispatch automation.

# I

Leading comrades in the State Council have pointed out repeatedly that energy resource and communications construction should be arranged around power. This formulation is receiving the most attention in the development of the electric power industry since the founding of the country. The electric power industry has developed rather quickly in recent years. Total installed generating capacity in China reached about 80 million kW at the end of 1984 and annual power output exceeded 300 billion kWh. By the end of this century, total installed generating capacity will surpass 200 million kW and power output should reach 1 trillion kWh. The increase in installed generator capacity and power output also will lead to the rapid development of large grids. The large interregional southwest--northwest connecting line already went into operation at the end of 1983. Development plans are: to change the Guangdong-Guangxi Joint Grid into the South China Grid at the end of 1985, to join the Northwest and Central China Power Grids in 1986, to join the Northwest and North China Power Grids in 1987, to join the Central China-East China and the Northwest-Southwest Power Grids in 1988, and to join the Northeast and North China Power Grids from 1990 to 1992. Developments may make it possible for the Northeast and North China Power Grids to be joined ahead of schedule. This means that by around 1992 all of China will be linked in a 100 million-plus kW integrated grid. After the large interregional grids are linked together, the dispatching system of China's electric power system will develop from the present three-level dispatching to four-level dispatching (that is, national dispatch, grid dispatch, provincial (and municipal) dispatch and prefectural dispatch, with management and control by levels.

Growth in the size of power grids has led to increasing complexity in connection structures, greater demand for monitoring and control information, and higher safety and stability requirements. A lack of advanced dispatching tools makes it impossible for power grid dispatch to have a unified view of the overall situation and operation of entire grids. Continual expansion in grid scales means that power grid dispatch automation is not "flowers painted on brocade" that can be done without. Instead, it directly serves power grid dispatch and becomes an indispensable measure for safe and economical operation of electric power systems.

A failure of power grid dispatch automation to keep pace will bring some hardships upon us. After a 220 kV connecting line in the Southwest-Northwest Joint Grid went into operation, for example, the lack of monitoring and control measures caused more than 100 instances of breakdown during the year-plus since the grids were linked, which made it difficult to guarantee normal operation of the lines. Electric power systems are subject to frequent changes. An inability to collect information quickly will influence the ability of dispatchers to deal quickly with accidents, which often will

engender collapse in a grid and power outages over large areas, causing serious losses to the national economy. An accident in the Hubei Power Grid in 1972, for example, caused losses of several 10 million yuan and seriously endangered the safety of the Wuhan Steel Mill. A major power outage in Anhui in July 1980 reduced power transmission by almost 1 million kWh. All these grid accidents were closely related to backward dispatching measures and to inappropriate and slow handling. It is obvious that greater grid development makes automation ever more urgent.

Considerable economic benefits can arise from utilization of power grid dispatch automation systems, development of economical dispatch methods in large grids and rational utilization of energy resources. Calculated at an energy conservation rate of 0.5 to 1 percent, a grid with a capacity of 100 million kW could conserve 1 to 2 million tons of standard coal yearly. Economical dispatching in a large grid, however, is not a simple matter. It requires a large number of calculations as well as the capacity for automatic dispatch of generated power output. A lack of grid automation makes it impossible to achieve economical dispatching in large grids. Many grid dispatchers and provincial (and municipal) dispatchers have utilized computers to develop economical dispatching work in recent years, and different degrees of economic results have been obtained in all of them.

The trend toward a continual rise in the cost of energy in the world today and the relative decline in the price of electronic computers have greatly improved the returns on investments in automation. Capital invested in power grid dispatch automation not only is economical because of the returns from economical dispatching but also can be recovered within 3 to 5 years. Moreover, there are inestimable benefits from reduced losses due to the prevention of the occurrence and spread of accidents. Statistics from 19 companies in the United States indicate that, on the average, the investments can be recovered in 3.8 years. This makes power grid dispatch automation an effective measure that costs little, provides quick results and improves the safety and operation levels of grids, and it provides rather substantial economic results.

## II

Dispatch automation work began rather early in China. An Automation Committee was established in the Northeast [Power Grid] in 1958 and it began using automatic frequency regulation and modellers to do economical dispatching. The North China, East China and Northeast [Grids] began using computers in the late 1960's and early 1970's for monitoring grid safety. For more than two decades, large numbers of employees in scientific research, design, manufacturing, production and other units in electric power departments throughout China have explored, carried out difficult research, dared to move forward and made bold attacks on key problems, and they have gained much experience and many results. More than 25 national grid dispatchers, provincial (municipal) dispatchers and prefectural dispatchers now have achieved information measurement, transmission, collection, monitoring, processing,

interpretation, printing and other monitoring functions to different degrees. The North China Power Grid dispatcher and the Nanjing Automation Research Institute have cooperated to develop dual-computer systems, and the power grid dispatch automation system imported by the Hubei Province grid now has achieved safety monitoring functions of the 500 kV system. On the basis of achieving remote operation and improving the precision of measurements and of system reliability, the Shandong Province dispatcher and Zhengzhou Prefecture dispatcher now are making formal use of remote measurement parameters as a base for production reports and statistical analysis of operations. This has given dispatch automation an excellent reputation in the area of electric power dispatching. It has entered the utilization stage and has become an indispensable component part of dispatch operation.

In summary, there have been major achievements in power grid dispatch automation work. We also must take note, however, that although power grid dispatch at the present time has a certain amount of remote operation and computer equipment, many weak links still remain. The foundation of automation, for example, is poor, remote operation equipment is inadequate, capacity is small, reliability is poor and functions are incomplete. China has no industrial products for remote kWh measurement, power angle remote monitoring and other transformer and transmission equipment at the present time, and communications networks are weak. Backbone channels focused on microwaves have not been completed. Most remote operation equipment also is used for electric power line carrier wave channels and is of limited amounts and low quality. Real-time information from power generation plants and transformer sites often cannot be transmitted because of channel factors, sometimes to the extent that remote operation equipment cannot be put into use in some locations after it has been installed and debugged, and the level of automation in power plants is low. None of the 10,000 kW and larger thermal power generators now made in China have power dispatching components and there is a low rate of automatic thermal power input. Many problems also exist in the controllability of primary equipment. This makes automatic control of power generation in power grids and economical dispatching quite difficult to achieve. This is due precisely to this series of factors that have blocked the real benefits arising from power grid dispatch automation systems.

The level of power grid dispatch automation in China is rather low at the present time and is far behind advanced foreign levels. The use of computers for power grid monitoring and control in foreign countries began during the early 1960's and developed very quickly following the major power outage in the eastern United States in 1965. According to statistics, there now are more than 200 power grid dispatch control centers in the world and all of them have achieved safety monitoring and control functions. Some have reached a middle-grade level through achievement of automatic power generation control and economical dispatching functions. About 10 percent have reached a top-grade level and have safety analysis and other functions.

China's current situation, the problems that exist and the great disparities in comparison to foreign levels have caused us to realize clearly that there are major difficulties and arduous tasks involved in solving the problems

that exist and transforming the backward situation in power grid dispatch automation in China as quickly as possible. We have a great deal of work to complete.

### III

Below, I will offer some opinions concerning ways to accelerate construction work to implement power grid dispatch automation.

#### 1. Strengthened leadership and support from all areas.

Power grid dispatch automation involves systems engineering and cannot be seen merely as a task of dispatching departments since it concerns information, passive control facilities in plants and stations, basic automation and other areas. It involves scientific research as well as project implementation, installation and production as well as equipment maintenance, and hardware as well as software. It is comprehensive work concerned with entire grids. This means that it will be difficult to do good work in these areas without strengthened unified leadership and support from all areas. A problem appearing in one link can affect the implementation of systems engineering as a whole. For this reason, all departments must strengthen leadership and make power grid dispatch automation an integral part of electric power development plans. Communications, remote operation and basic plant and station automation should be designed and constructed at the same time as power transmission projects. Outdated and backward equipment gradually should be rebuilt and replaced. Moreover, we should organize scientific research, design, manufacturing and other units to develop, outfit and supply complete dispatch automation systems.

#### 2. Carry out control by levels according to power grid management systems and the principle of a division of labor in dispatching.

In order to adapt to the need for voltage division grades in power grids and for regional management, all dispatch automation systems in modern power grids use multilevel control systems. This can aid in conservation of channels and improved investment efficiency. It is easy to guarantee the reliability of automation systems and it also can adapt better to the development of modern technical levels.

After a national grid is linked up, dispatching management and control will be divided into four levels in accordance with China's conditions. National dispatching is responsible for management of connection line control patterns and cross-supply loads, and it coordinates the operational patterns for each large regional power grid. Large regional grid dispatching is responsible for safe and economical operation of entire grids and for adjustment of voltage and cycle quality. The load of connecting lines is controlled according to stipulations with a focus on managing the primary gridwork and backbone power plants. Provincial (and municipal) dispatching is responsible

for management of power grids and power plant operation within the scope of their jurisdiction, and they complete power generation and supply plans or control loads on connecting lines. Prefectural dispatching is responsible for regional grid operations and for control of electricity usage loads according to plans.

The electric power industry system in China has undergone a period of reforms since the 3d Plenum of the 12th CPC Central Committee. To stimulate the economy and motivate the initiative of all areas to manage electric power, reforms in China's power grids should emphasize that, with a prerequisite of unified dispatching, more economic measures should be used in management. There are several types of situations in power grid management in the world: the Soviet and East European patterns use a high degree of centralized management; the United States, Japan, and West Germany use economic measures to manage dispatching, and so on. There are different views at present concerning what type of management China should adopt, and the correct route for power grid management in China should be determined according to China's conditions. Each power grid has its own situation and can employ different patterns under the principle of unified dispatching and management by levels. Things should not be done indiscriminately.

In the future, regardless of the pattern actually employed to manage power grids, all dispatch automation systems should determine the corresponding functions and outfitting programs according to the scope and tasks of their jurisdiction. When multilevel control of power grids is achieved, dispatching at all levels requires the organization of an information exchange network for close links between upper and lower level dispatch automation systems in order to guarantee the optimum results from power grid operation.

### 3. Take the route of integrating imports with self-development.

Although power grid dispatch automation in China did not start all that late, the long period of interference from "left" policies has left us substantially behind advanced world levels. If we close our gates and turn inward, the disparity will become even greater. We should not take the old road of so-called self-reliance and start everything from the beginning. Instead, we should make full use of the favorable situation of a policy of opening up to the outside and take the road of "importing, digesting, developing and creating" to accelerate the pace of construction of power grid dispatch automation in China. Imported items should be oriented toward utilization and consider economic results. We should adopt mature matching systems with complete functions in the near term, and we also should leave room for development. Imports should be focused on advanced technologies. Besides primary equipment, we also should include the various subsidiary systems and interfaces and various types of support software and applied software. We definitely must strengthen work to digest and absorb imported technologies, and scientific and technical forces should be organized for import projects to improve our starting point in technical work. There should be conscientious digestion followed by development and innovation. When the conditions permit we also can engage in cooperative development, joint investments in production and so on so that in the process we study, digest, improve and gradually train our own staffs to serve the realization of comprehensive dispatch automation.

China has a total of more than 260 dispatching organs and dispatch automation cannot depend on imports. Imported automation systems can only account for a small portion. The greatest part must depend on our forces for installation. China's scientific research, manufacturing, production operations, design and education departments have certain real strengths and experience in the area of power grid dispatch automation, and we should continue to rely on forces within China to motivate positive factors in all areas and pool the wisdom and efforts of everyone for joint attacks on key problems.

Many dispatch automation systems in foreign countries are handled through contracts with systems engineering companies. These companies purchase equipment themselves. The systems are debugged within the companies and they develop procedures to provide complete sets of dispatch automation equipment to the user according to the contract. In most cases in China, however, the users themselves organize the systems. The fact that the users lack systems design experience means that a great deal of time is spent and that various problems are hard to avoid when finished. Moreover, there are many instances when work at a low level is done repeatedly. I believe that we also can rely on forces within China to set up several such systems engineering companies to provide complete sets of systems equipment and systems for all levels of dispatching in China.

4. Start from reality, seek applied results and be concerned with economic benefits.

Systems reliability and economy should be stressed for all levels of dispatching in power grid dispatch automation plans and designs. This is especially true of the need to use actual conditions in electric power systems and levels of development to analyze and consider the levels of automation that can be reached during each different stage of development and to determine precisely what problems should and can be resolved.

During implementation of dispatch automation, we should spend less, handle more, strive to use the most advanced and achieve results as soon as possible. With the present continual expansion of power grids and the substantial increase in information, the most urgent need in dispatching is safety monitoring of power grid operations. This is the focus of computer applications and should be popularized at all levels in dispatching. The types of computers to be selected should be determined according to the division of responsibility for dispatching and the requirements of automated functions. Grid dispatching and some provincial dispatching has made grid lines more complex and greatly increased information. Besides safety monitoring, rather high capacity and high capability computers should be selected for such functions as economical dispatching and connecting line load control. Some fairly small power grids can use lower grade computers. We certainly must oppose such tendencies as not starting with actual conditions, not seeking applied results and failing to consider capabilities while instead seeking fashion, favoring the large while ignoring the small and favoring the expensive instead of the inexpensive. The fact that we will spend more money is not the only problem. Higher grade equipment is more difficult to develop and takes longer periods to develop, often to the extent that there are repeated delays involved in putting it

into operation. Doing things in this way not only will not make it possible to achieve results as early as possible but also will effect the urgency of dispatching. Rather small investments in dispatching have been used in some places for microcomputer applications in power grid monitoring within a short period of time. They have solved real needs and achieved excellent results. This deserves extension and utilization.

Technical and economic analysis should be done to decide whether or not to replace power grid dispatch automation systems already in operation. According to statistics for 19 companies in the United States, [the cost of] a dispatch automation system can be recovered in 3.8 years on the average. The systems have an average useful life of 13.7 years, however, the least being 7 years and the longest 20 years. In computer applications, therefore, we cannot change our minds as soon as we see something new because of the constant changes in electronics products, nor can we simply pursue the newest levels. Instead, we should consider the question in terms of power grid development and the corresponding automated functions, and we should make full use of the investment benefits in existing automation systems.

#### 5. Strengthen work in basic automation.

China's power grids are rather weak in the areas of information, remote operations and plant and station automation. This has become the key question that blocks the development of power grid automation, and it should receive attention from all levels of leadership. Power grid dispatch automation has been in existence for many years now, but there have been few instances where true control functions have been achieved. The main reason lies in poor basic automation. Some comrades show some interest when the question of computer purchases comes up, but they do not pay enough attention to grasping basic automation work. We must ask then, are we purchasing computers as knick-knacks or to actually use them in power grid operations? Power grid dispatch automation is a system and computers are better than the human brain. Remote operation, channels and plant and station automation are better than the five senses and human drive. They can play their role only when they are matched organically.

We must, of course, acknowledge that basic automation work covers a broad area and involves many aspects. It is hard work, and it is an old and tough problem that has not been solved for a long time. We cannot retreat when we see difficulties, however, but instead should think of advancing when we learn of problems, be earnest in implementation of concrete measures and focus on work in this area. We should consider gradual replacement, retooling and supplementation of automated equipment already in operation during the process of solving these problems. New automatic projects should be included in plans, designs, capital construction, examination and acceptance to make gradual changes in the current situation.

#### 6. Pay attention to personnel training.

Personnel are the key to the ability to achieve power grid dispatch automation. Personnel come from two areas: one is from training in existing institutions

of higher learning and polytechnical schools; the other is by making use of existing personnel. China's overall situation is that there are few power system automation specialists and that they are of poor quality and cannot adapt to development of power grid automation.

We must take many paths if we wish to train personnel as quickly as possible. Apart from supporting graduate and undergraduate students and polytechnic students, attention also should be given to technical training for on-the-job personnel. Television universities, correspondence universities, night colleges, classes for those released to study, short training courses and so on are good forms to use for raising the professional levels of existing personnel since they help them solve problems of insufficient knowledge and renewal of knowledge.

Power grid dispatch automation is a topic that has a rather strong systematic nature. Mere reliance on specialized knowledge in one area is inadequate for a full understanding. When we develop a comprehensive dispatch automation system, we not only must be familiar with computers but also must have a corresponding understanding of electric power systems, power grid dispatching, remote operations communications and other specialized knowledge before a systems project can be completed. Moreover, this type of rather comprehensive specialized strength is indispensable in development. For this reason, personnel on the job, even those who graduated from conventional colleges, should strive to study, dare to practice and make continual improvements. We should give attention to specialized forces in these areas and be concerned with selection, and we should give them further focal training.

One path to take for training our own specialized staffs is to import, digest and absorb advanced foreign technologies and management methods. For this reason, we should select personnel who study well to do work related to import projects, cooperative development and joint investments in production, and use work in these areas to improve specialized levels.

All levels of leadership in electric power departments should study or be trained in related specialized knowledge so that they understand power grid dispatch automation and develop work in this area faster and better.

#### 7. Capital should be collected through many channels.

Power grid dispatch automation requires a lot of capital. Simple reliance on the strengths of the ministry will be insufficient. We must make use of initiative in all areas. The ministry has adopted a pattern of direct allocations for some key projects to guarantee the scale of utilization of administrative expenditures. Power grid bureaus, provincial bureaus, electricity supply bureaus and regional electrical industry bureaus should collect capital through many channels to guarantee the implementation of renewal, transformation and new construction automation projects.

Comrades, power grid dispatch automation is an objective need and urgent requirement for electric power development. We must do a great deal of work if we are to make progress in this area.

We hope that the discussions and exchanges during this conference will collect everyone's correct viewpoints and constructive opinions to enrich and perfect the "Outline Regulations for National Power Network Dispatch Automation" so that they have a broader democratic nature and high degree of authoritative-ness and can thereby direct the construction of national power grid dispatch automation. After everyone goes home, they should be resolute in making good automation plans for power grid, provincial and local dispatching under the guidance of this plan and develop work solidly in this area to make progress and obtain results.

Comrades:

The goal of developing power grid dispatch automation is a magnificent one. Time presses us and the tasks are arduous. We certainly must be determined to achieve this goal and have a sense of urgency for completing the task. We believe that under the correct leadership of the CPC Central Committee and the impetus of the spirit of reform, everyone will work for the good of the prosperity of the country, that they will work hard, overcome difficulties and are to climb so that power grid dispatch automation work in China moves forward and that they make a contribution to the development of the electronics and information industries!

12539/12980

CSO: 4013/168

## POWER NETWORK

### RECAP OF SYMPOSIUM ON NATIONAL POWER GRID DISPATCHING AUTOMATION

Nanjing DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] in Chinese Vol 9, No 5, Sep 85 p 3

[Remarks by Cai Yang [5591 3152] Office of Dispatching and Communications, Ministry of Water Resources and Electric Power: "Concluding Statement at Symposium on Planning for National Power Grid Dispatching Automation"]

[Text] This symposium on planning for the automation of power grid dispatching has been the first plenary session since the formation of the specialized group on modern management systems for power grid monitoring and dispatching.

The meeting has been a successful and lively one, with talks by the leadership, reports at the plenary session, exchange of experience and small-group symposiums, an exhibition of results, and numerous on-site photographs of automated dispatching; we have achieved the results expected of the symposium and have derived benefit from it, and it will help promote the development of automated dispatching. Based on the reports and discussions presented, I would like to offer the following views for future reference.

1. The automation of power grid dispatching is important and must receive serious consideration at all leadership levels.

As power grids expand and are tied together, automated dispatching has become an essential method of assuring power system safety, economy and normal operation.

It affects all departments involved in power generation and power supply within each grid, it brings together numerous specialized fields such as communications, computers, power plant automation and the like, and it requires cooperation between research and design units: thus it is an activity that involves the entire power grid.

The State Council's leadership group on developing electronics has included the automation of power grid dispatching among the key computer applications areas, and the State Council and ministry leadership attach great importance to this work. Therefore the leadership of all offices must also accord it

full importance and must organize the relevant departments, allocate the work, coordinate activities, and make an effective effort in the automation of power grid dispatching.

2. Automation of power grid dispatching is a complex process, whose development and complementation must be organized by the systems engineering approach.

Automation of power grid dispatching is a complex system with far-reaching effects which is highly technological, requires the collection and processing of real-time information, can carry out various types of operational calculations and upward and downward exchange of data, will promote improved man-machine interaction, makes stiff demands on capabilities and reliability, and is more complex than installing ordinary general-purpose computers. To develop a complete automated dispatching system will require several hundred man-years of work spread over 5 to 10 calendar years, i.e., it will entail a considerable investment of manpower and will take a rather long time to implement. Therefore, experience indicates that in addition to organizing schools and design, research and similar organizations at various dispatching levels to carry it out, we will need to plan the establishment of various systems engineering units, develop several different series-produced systems for different dispatching tasks, such as the four product models proposed by the Nanjing Automation Institute to meet dispatching needs at the various levels, and gradually proceed from dispersed development to system contracting in order to accelerate the development of power grid dispatching automation.

3. Automation of power grid dispatching is a formidable undertaking which must be performed at all levels, with all tasks properly allocated, and must be carried out stage by stage in accordance with targets.

As a result of discussion, revision and supplementation, this symposium has designated targets and requirements for the automation of systems dispatching with a 5-year automation planning cycle, while various dispatching automation systems must meet capability requirements for 10 to 15 years out, so that the plan provides for 10-15-year conceptions. By the year 2000 the entire country's power grid is expected to have established four-level dispatching of the control systems under various jurisdictions: this target stems from actual needs, but realizing it will be arduous. Therefore the various power grid offices, province offices and regional offices must follow the requirements laid down in Vice-Minister Zhao's report and the targets laid down in the plan and must implement each item, particularly the items scheduled for the period before 1990, and carry them out in phased fashion. In implementing the 1990 targets, we must focus on a variety of complete standard systems suited for power grid dispatching, province-level dispatching and regional dispatching, we must make good preparations for future development, and we must make a contribution to speeding up construction.

8480/13104  
CSO: 4013/9

## POWER NETWORK

### REPORTS AT AUTOMATED POWER GRID DISPATCHING SYMPOSIUM EXCERPTED

Nanjing DIANLI XITONG ZIDONGHUA [AUTOMATION OF ELECTRIC POWER SYSTEMS] in Chinese Vol 9, No 5, Sep 85 pp 4-9, 24

[Article: "Excerpts from Statements at Symposium on Planning for Automation of National Power Grid Dispatching"; some paragraph numbering added]

[Extract] Editor's note: The conference reports at the symposium on planning for automation of national power grid dispatching and Deputy Minister Zhao Qingfu's [6392 1987 1133] talk at the conference were printed in issue No 4 of this journal. In this issue, for our readers' convenience we publish excerpts from the reports given at the conference by certain power grid office general dispatching offices, the Nanjing Automation Institute of the Electric Power Planning and Design Academy, and the Electric Power Research Academy.

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1. The statement by the general dispatching office of the North China Electric Power Management Office was entitled "Experience and Insights in Effective Dispatching Automation". Below we excerpt sections 2, 3 and 4 (Chai Yuhe [2693 3768 0735])

#### 2. Emphasize "Remote Control" Work

Remote control is the basis of power grid automation. To institute on-line computer operation we must first effectively introduce power grid remote control and provide reliable channels for transmission of remote control information. In the case of the Beijing-Tianjin-Tangshan power grid, for example, in the 5 years from 1979 to 1984 there was an average of 65 advances a year in remote measurement and related development of remote-control signal lines designed to make use of a variety of computer on-line operating capabilities, to furnish dispatching and operations personnel with more correct real-time information and to assure that the on-duty dispatching personnel correctly control the grid correctly and operate it normally and safely.

A large amount of the real-time information for the on-line computers comes from remote control devices; and the remote-control signals must therefore have a rather high correct function rate and the telemetry must have high

precision. Accordingly we must make a major effort in improving the remote-control correct function rate and telemetering precision as the basis of power grid automation.

### 3. Selection and Standardization of Remote Control Equipment

Selection of remote control equipment models and standardization of the assortment of equipment constitute an extremely important aspect of power grid automation management. Our choice of equipment is based on the following principles: (1) we use industrially produced remote control equipment based on mature technologies; (2) the equipment selected must be compatible with on-line computers; (3) the remote control equipment must be reliable and effective.

Upgrading and modernization of remote control equipment must be approached from the systems engineering viewpoint, focusing both on macro-scale development, i.e., dissemination, and on vertical development, i.e., compatibility with sophisticated technologies.

In this respect we have encountered difficulties which have led us to certain insights. Starting in the early 1960's we had various models of digital remote control equipment which were fairly effective, but as automation technology progressed and equipment was modernized and updated, and as we studied the plans for developing automated power grid dispatching, we realized that this diversity of remote control equipment models was not conducive to the healthy development of dispatching automation and that the problems would be particularly noticeable in regard to importation of automated systems.

As a result of painstaking research, repeated comparisons and the weighing of benefits and disadvantages, we finally decided to unify our telemechnics equipment and retire the odd models, making the transition to the WYZ [expansion unknown], whose technology is relatively mature. The transition will be completed in 1985; experience has shown that the decision was correct and that it has promoted the development of automated dispatching and laid down a firm foundation for on-line computer operation.

### 4. Strengthening management of remote control lines by a master system

In order to strengthen operational management of remote control lines by the power grid master system and to assure correct transmission of power grid safety monitoring information, we drew up the "Beijing-Tianjin-Tangshan Power Grid Procedures for Operation Management of Remote Control Lines by the Master System." This document specified the division of labor between the system's, the remote control lines and the corresponding interface equipment, provided technical specifications for line monitoring points and laid down certain specific regulations regarding operating management.

#### 1. Assignment of specialized equipment maintenance work

Remote control lines: these are managed by the communications departments at the various levels.

Remote control interfaces: all remote control interface equipment including audio-frequency modems is centrally managed by the remote control departments.

In the case of terminal audio-frequency cables, because conditions vary in different plants and stations, no uniform rules were laid down: they are to be specified by the individual plants and stations in accordance with their particular circumstances, with the results to be reported to the general dispatching office for filing.

b. Regulations and technical specifications regarding remote control line monitoring points

Monitoring points are locations that monitor the audio-frequency signal transmission quality of the remote control and in addition are the points to which responsibility is allocated in specialized communications and remote control management. Monitoring points at the sending end, receiving end and switching stations are provided for. The technical specifications for monitoring points are based on the main technical characteristics of the complete circuits of ordinary telephone channels, including the range of signal levels, signal-to-noise ratios and signal amplitude-frequency characteristics, but not including signal element distortion in digital transmission channels or code errors.

The master system remote control channels for newly built plants and stations and the resulting adjustments in the remote control channels of existing plants and stations are included among the lines items in new electric power construction projects and should be built together with the relevant electric power projects.

d. Management and operating and maintenance personnel specializing in power grid communications and remote control should intensify their efforts at coordination and create favorable conditions for their opposite numbers.

II. The report by the chief dispatching office of the East China Power Management Office was entitled "Report on the East China Power Grid's Dispatching Automation Plan". Below we excerpt part 2, omitting section 1, "Review of Automation of the East China Power Grid," and section 3, "Insights and Plans."

The East China Power Grid automated dispatching plan.

1. Plan Standards:

At the instance of the East China Power Grid Automation Working Group, several principles for drafting standards regarding the planning of automated dispatching at the general dispatching office level and the province and municipality dispatching office levels were discussed and agreed upon:

a. The planning must follow the relevant technical policies and short-term implementation guidelines of the national government, the Ministry of

Ministry of Water Resources and Electric Power and the power grid office must take account of future development, the dispatching system, and requirements regarding capabilities, technology and the like.

b. In keeping with the objectives of power grid modernization, planning must meet the requirements that arise regarding such aspects of automation as electric power quality, economic benefits, and safe operation.

c. The automation system must be formed into networks and must be in accordance with the technical principles that spring from network requirements.

d. The plans must be drawn up at each level in accordance with the standards documents in the dispatching management system and must fit into the overall plan for dispatching automation in the East China power grid.

e. The dispatching automation plan must be closely coordinated with the initial power grid plan and the communications plan so as to form a component part of the power grid office's overall plan.

## 2. Guiding Ideas of the Plan

a. Level-by-level structure of dispatching automation. Based on the East China Power Grid's 1980 three-level allocation of dispatching management work, the general dispatching office will directly control 500-kV plants and stations and 220-kV interprovince tie lines and their power plants, while the province and municipality dispatching offices will directly control 220-kV power grids within the provinces and municipalities and will oversee interprovince tieline power levels. Accordingly, dispatching automation should also be divided into levels on this principle, i.e., the general dispatching office will control 500-kV systems and 220-kV interprovince tie lines, and the province and municipality dispatching offices will control the 220-kV systems subordinate to them, while the local dispatching offices will control 100-kV systems and lower distribution networks. There will be exchange of information between lower- and higher-level automation systems.

b. Dispatching automation capabilities plan. Before 1990, the general dispatching office will perform safety monitoring within its range of jurisdiction as well as some generation control and economic load distribution, as well as a small amount of remote nonreactive power and voltage control; the province and municipality dispatching offices will exercise safety oversight within their areas of jurisdiction and when conditions permit will engage in some power generation control and local voltage regulation for control of power exchange via interprovince tie lines.

c. Data collection by dispatching control computers: the method of information collection by the dispatching computers must meet the speed requirements of computer processing, and accordingly the general dispatching office and the province and municipality dispatching offices must use direct data collection and direct issuance of commands to the power plants and stations directly under their control, while in the case of the plants and

stations not directly under their control, either the lower- or higher-level dispatching office may dispatch and forward information. Accordingly, when a power plant or station simultaneously has higher-level and lower-level control tasks related to dispatching, it will generally need to use the "one send and two receive" remote control mode.

For higher and lower level information forwarding in connection with dispatching, in the near term we will use microcomputer remote-control forwarding; subsequently, when computer networks are implemented, we will use computer network information exchange.

d. Computer configuration: for convenience in managing software and hardware maintenance and in resource sharing and to promote the formation of computer networks, the general dispatching office and the province or municipality office levels should use the same computer models. In general terms, the basic tasks in dispatching automation can be classified as: safety monitoring, safety analysis, energy management, and system control. The above tasks must all be performed in keeping with the dispatching management systems of the East China general dispatching office and the provincial and municipal dispatching office levels.

Prior to 1990, all province and municipality dispatching offices will develop safety monitoring capabilities on the basis of existing facilities.

e. Computer communications networks: The initial objective in establishing computer networks is to implement data transmission and the ability to exchange information between the various dispatching levels; whether we subsequently proceed to "resource sharing," with the general dispatching office's computers performing real-time computation and analysis for the entire network, will depend on needs and capabilities.

The main function of the computer network is: in hardware, to implement computer interfacing; and in software to unify communications protocols and establish the requisite computer operating systems. The CCITT [International Consultative Committee on Telegraphy and Telephony] X25 protocol has already been designated the communications protocol for the East China Power Grid general dispatching office and the province and municipality dispatching office level's; the East China general dispatching office and the Ministry of Water Resources and Electric Power communications will use the BSC protocols.

f. Computer applications software: Prior to 1990 the General Dispatching office is scheduled to develop the following applications software:

Safety monitoring: primarily regular data collection, processing, display, over-limit monitoring and automatic record keeping.

Power generation control: computer control of power stations directly under the control of the general dispatching office such as Xin'an Jiang, Fuchun Jiang, Wangting and Baogang major power plants and newly-constructed 500-kV power plants, with periodic issuance of generating unit output adjustment commands and automatic control of power grid frequency.

Economic dispatching: initially, economic load distribution for the four major plants in terms of microincrements of coal consumption (or production cost), and subsequently, periodic calculation of the microincrement rate for the entire network and issuance of matching adjustments to the province and municipal dispatching offices.

In the future, when mainframes are installed in the province and municipal dispatching offices, the development of general-purpose software is planned.

Applications software development for 1990 and after:

An energy management system (EMS): on-line load prediction, improvement of the level-by-level economic dispatching system, improved line loss analysis, production costs analysis and the like.

Safety analysis: network awareness, network equalization, state estimation, on-line high-water incident forecasting and protective measures and the like.

Automatic control: automated voltage dispatching, nonreactive automatic adjustment, DC transmission power control and operating control and the like, starting with open-cycle operation and gradually proceeding to closed-cycle operation.

g. Remote control configuration: the East China general dispatching office and the province and municipality dispatching offices' remote control equipment will be based primarily on the interrogation-and-response mode in the future. The current round-robin remote control system will also be maintained for a time. The principal capabilities of the remote control configuration will be "one send and two receive" transmission of the information needed for two-level dispatching, on-site capabilities (including incident sequence recording), malfunction diagnosis and the like. The remote control information includes: for upward transmission, telemetry and remote signaling (switches, sluice gates, principal types of relaying and alarms), and upward forwarding of dispatching information, (telemetry, remote signaling volume), sequential event recording and the like, in addition to which the general dispatching officer will transmit the necessary real time information to the **Power Ministry's** Dispatching and Communications Office.

The downward-moving information includes remote dispatching (under-load allocation of generators, phase regulators, DC control stations and transformers), remote control (capacitors, resistors, and switch unattended at stations), and downward dispatching of return transmissions.

The mode of transmission of remote control information will initially be point-to-point dedicated lines for the interrogation-and-response mode of remote control, while the multipoint shared-line mode will be tried at the same time on an experimental basis. There will be dedicated lines for round-robin remote control.

h. Line requirements: Computers and telemechanics systems both require one main and one backup line; a malfunction in the equipment on either line must not affect normal operation on the other.

The channel speed will be 1200 baud on the two lines for the 500 kV system, and 1200/600 or 1200/200 baud for the 220-kV system. For computer communications, 1200 baud will be used in the near future and 4800-9600<sup>5</sup> baud later. The channel requirements include an error rate of less than  $10^{-5}$  and a signal-to noise ratio of at least 17.3 dB for telemechanics channels, while for computer data transmission the error rate must be less than  $10^{-5}$  and for the near term and subsequently less than  $10^{-5}$ .

III. The report by the general dispatching office of the Southwest Power Management Office was entitled "Planning and Implementation of Automated Dispatching in the Southwest." Below we excerpt the preface and part 4, "Future Plans."

The first stage of dispatching automation in the power grid of the Southwest Power Management Office, under the direct oversight of the Science and Technology Bureau of the Power Ministry and of the Dispatching and Communications Office, was begun in December 1981 by the Nanjing Automation Research Institute of the Power Ministry and the general dispatching office of the Southwest Power Management Office. In the past 3 years we have drafted an implementation plan and a technical program and developed and assembled a hardware and software system. The project is now approaching completion and will soon be put into on-site use.

#### Future Plans

It is impossible to manage a modern power grid effectively without computers. Implementation of automated power grid dispatching is an important way of assuring safe operation of the power grid and making the system more economical. The objective for which we are striving is to absorb the technology and experience of developed countries in accordance with China's situation so as to speed up our power grid construction and raise the standards of our modernized power grid management, so that power production will more effectively meet the standards of our modernized power grid management, so that power production will more effectively meet the needs of the four modernizations. The computerized power grid dispatching automation system adopted by the Southwest power grid, based on a two-machine configuration, is an attempt to proceed with this work.

At the same time, the various province and intermediate-level dispatching offices in the Southwest power grid have made general plans and implementation plans for their own systems. The Yunnan power grid, making use of foreign capital in the Lubuge hydroelectric station project has prepared to invite bids for an automated power grid dispatching system at the province dispatching office level. The Guizhou Province dispatching office is also making plans to develop a SCADA system. The West Sichuan and East Sichuan intermediate dispatching offices have been proceeding with work as their

financial resources have permitted. To accelerate progress in dispatching automation in the southwest power grid, we plan to proceed with the following main activities as our next step.

1. Further strengthening the planning of power grid dispatching automation at the various levels, proceeding, realistically and prudently to specify practicable implementation measures.
2. Dispatching automation work in the southwest power grid is already under way; the next step should be to put existing lines in order and to increase their speed as rapidly as possible, to designate and implement the various stages of the microwave trunk line project, to issue plans for power plants and stations that still lack remote control equipment and to install the equipment, and to draft plans for the gradual replacement of small-capacity outdated remote control equipment not suited to the requirements of power grid dispatching automation.

In order to meet the requirements of tie line load control, automated power generation control and economic dispatching, we must strengthen basic automation activities for the generating units in plans involved in frequency regulation, and we hope that an overall plan can be developed in this area. We must start by solving the problems regarding the technical level and production of frequency regulation and power regulation equipment; otherwise on-sign technical upgrading will be hard to carry out. In addition, we should clearly allocate the requisite technically appropriate automation equipment for generating units being newly designed so that future capital construction projects will not be handled as an afterthought; and we must create the necessary material conditions for speeding up power grid dispatching automation.

3. After the Southwest general dispatching office's data collection and safety monitoring systems go into operation, implementation of the various-level intermediate dispatching offices' power grid dispatching automation systems should begin. Implementation plans for the second stage of the general dispatching office's power grid dispatching automation system should be begun following consolidation and development of the first-stage capabilities. We are prepared to proceed realistically and resourcefully in order to create the conditions for implementation of capabilities in automated power generation control, economic dispatching, safety analysis and safety measures, starting with the installation of a high-grade power grid dispatching automation system based on series-produced computers in the general dispatching office, and to establish a relatively complete power management system for the power grid. At the same time, we will implement power grid automated dispatching systems on various scales and with various capabilities for the various dispatching departments at the province dispatching office level.

On this basis we will gradually implement a data communication system for the computers of the entire grid's power dispatching system and institute communications with the information network of the national dispatching center.

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## POWER NETWORK

### SICHUAN ADOPTS VARIETY OF MEASURES TO RESOLVE ENERGY SHORTAGE

Chengdu SICHUAN RIBAO in Chinese 1 Aug 85 p 2

[Article: "The Sichuan Provincial Government Calls Work Conference on 'Three Types of Power' To Resolve Serious Province-Wide Energy Shortage Problems"]

[Text] In order to solve the serious energy shortage in Sichuan Province, the Sichuan Provincial Government convened a Conference on Safe Electricity Use, Planned Electricity Use and Conservation in Electricity Use, originally planned for the fourth quarter of 1985, ahead of schedule in July in order to guarantee electric power throughout Sichuan. The province now has a power shortfall of about 2 billion kWh. In order to assure the planned use of electricity, the provincial government has turned over its power distribution program to planning and management committees in all prefectures, cities, and autonomous prefectures to allow them to study it closely, calculate precise accounts, suggest countermeasures and implement it item by item. As for units which exceed electricity usage plans, a decision was adopted to practice "limitations for those who exceed quotas, repayment tomorrow for today's excesses," and economic sanctions adopted as necessary for power that is hard to recover through deductions. Moreover, based on the current situation of excessive peak loads and peak-to-valley differential of more than 800,000 kW during the present water-rich period, the provincial government has implemented a policy of differential peak-to-valley prices to encourage users to use more electricity during valley periods and less during peak periods so as to regulate loads and conserve electricity. At the same time, they formulated the "reward and punishment method to control peak loads, raise peak load rates and balance out power usage rates" to spread out peaks and fill in valleys so as to balance power usage and reduce problems of braking to restrict power and low-valley idleness.

In order to make good arrangements for electricity use during the dry period this winter and next spring, the government of Sichuan has organized the addition of generators with an additional 150,000 kW in output and implemented "higher prices coming and going" for electricity. Moreover, they have implemented floating differential prices for rainy and dry seasons and for exceeding plans to encourage all enterprises to use more electricity during the rainy season and less during the dry season, and to encourage electric power departments to increase the output of energy resources and alleviate the

contradiction between energy resource supply and demand. Electrical power shortages are restricting economic growth throughout Sichuan. The province is determined to seek every avenue to bring the 40,000 kW Yuzifu generator, originally set for startup in 1986, into operation and joined with the grid ahead of schedule in July 1985. Moreover, they have speeded up progress in the expansion projects at the Baima and Jiangyou power plants. They are focusing on preliminary work for those power plants that have been selected. The government of Sichuan also has called on electrical power departments to implement management by goals, strengthen regulation, improve economic responsibility and do good conservation work themselves. They have proposed ten measures for electricity conservation in society and guaranteed the conservation of about 500 million kWh during 1985. The conference also made arrangements for safe electricity use.

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CSO: 4013/181

## POWER NETWORK

### SICHUAN TO BUILD FOUR LARGE POWER FACILITIES

Chengdu SICHUAN RIBAO in Chinese 5 Aug 85 p 1

[Article: "Sichuan To Participate in Joint Investment With Ministry of Water Resources and Electric Power To Construct Four Large Power Facilities"]

[Summary] The Sichuan Provincial Government recently decided to make a joint investment with the Ministry of Water Resources and Electric Power to construct four large power facilities in Sichuan during the Seventh Five-Year Plan.

Sichuan does not have and will not have for a time to come, sufficient power to meet demand. This has become one of the primary contradictions for invigoration of Sichuan's economy. State investments already arranged for construction of new and additional generator installations can only supply key state construction projects and the electricity needs of city governments and daily needs of urban and rural people. Any other increases in electricity use must depend on raising capital to develop electricity. For this reason, the government of Sichuan specially formulated the three kinds of capital raising methods of "authority to purchase and use electricity, raising capital through shareholders and dividends, and raising capital by repaying principle and interest" and they are suggested to the capital units for voluntary selection. All units that raise capital have the right to use the electricity. To speed up electric power construction, the provincial government has decided through consultations with the Ministry of Water resources and Electric Power that, besides the 500 million yuan in capital raised by Chongqing City itself for construction of the new Luohuang power plant, the expansion of the Jiangyou power plant and construction of the new Huangjuezhuang power plant and the Ertan hydropower station will be included in joint investment construction projects during the Seventh Five-Year Plan. Sichuan will raise 1.75 billion yuan in capital for these three projects.

To implement capital construction tasks for developing electric power as quickly as possible, Sichuan Provincial Vice Governor Ma Lin [7456 7792] called together directors of planning and economic commissions from a total of ten cities [and prefectures] including Chengdu, Zigong, Nanchong, and Daxian and responsible persons from the Sichuan Provincial planning and economic commissions and from the Southwest Electric Power Management Bureau for topical research.

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CSO: 4013/181

## POWER NETWORK

### GUANGXI POWER INDUSTRY DEVELOPS RAPIDLY

HK140602 Beijing ZHONGGUO XINWEN SHE in Chinese 0642 GMT 13 Nov 85

[Text] Nanning, 13 Nov (ZHONGGUO XINWEN SHE)--Guangxi has witnessed great development in the power industry during the Sixth Five-Year Plan period. The installed capacity contributed [word indistinct] newly built and expanded hydropower and thermal power plants, each with a generating capacity of 25,000 kilowatts or above, totals 585,000 kilowatts. The installed capacity of small hydropower stations in various places has increased by a total of 134,000 kilowatts; 220-kilovolt power transmission lines with a total length of 789 kilometers have been laid; and a number of new transformer sub-stations have been built.

Dahua Hydropower Station is the first large hydropower station to be built on the Hongshui He. The initial phase of this power station has an installed capacity of 400,000 kilowatts. So far, the station has generated 2,442 million kilowatt-hours of electricity, equivalent to a value of more than 150 million yuan, since its four water turbogenerator units were put into operation in December 1983. As for the No 7 and No 8 generating unit extension projects of Heshan Thermal Power Plant, which were begun during the Sixth Five-Year Plan, the No 7 generating unit, with an installed capacity of 100,000 kilowatts, was installed and put into operation in June this year. Also put into operation in the same period was the No 3 generating unit of Tiandong Power Plant, with an installed capacity of 25,000 kilowatts.

Guangxi has also made great progress in the construction of power transmission networks during the Sixth Five-Year Plan. Among the completed power transmission projects are the Heshan-Liuzhou power transmission project, the Liuzhou-Guilin 220-kilovolt power transmission and transformer project, the Dahua-Etan power transmission project, and the Dahua-Nanning power transmission and transformer project. The Heshan-Laibin-Wuzhou 298-kilometer power transmission line, part of the Guangdong-Guangxi joint power transmission network project, and the Wuzhou 90,000-kilovolt ampere transformer substation, both completed in late October this year, have also been put into operation.

Yantan Power Station and Tianshengqiao Lower Dam Power Station on the Hongshui He are state-run key projects started in the Sixth Five-Year Plan period. At present, the preparatory work for the construction of these two hydropower stations is going on quickly. Meanwhile, the preliminary design work for Tianshengqiao Upper Dam Power Station and the Hongshui He Longtan Hydropower Station has begun.

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CSO: 4013/25

## POWER NETWORK

### ZHEJIANG DIVERSIFIES POWER SOURCES

OW151110 Beijing XINHUA in English 1031 GMT 15 Nov 85

[Text] Hangzhou, 15 Nov (XINHUA)--Coastal Zhejiang Province has expanded its power industry by diversifying power sources, according to provincial authorities.

It expects to have a total power generating capacity of 3.8 million kW by the end of this year, 40 percent more than in 1980, the year before the Sixth Five-Year Plan period. Electricity output will grow 90.8 percent.

Officials attributed the increase to a simultaneous development of hydroelectric, thermal, nuclear, wind and tidal power.

The province now has 6,000 hydroelectric power projects with a combined generating capacity of 750,000 kW of which newly added capacity accounts for 20 percent.

Expansion and construction of thermal power plants increased a combined generating capacity of 955,000 kW in the last 5 years, exceeding the total installed in the 30 years before.

Construction is now in full swing on the Qinshan Nuclear Power Plant, which will have a generating capacity of 300,000 kilowatts. The power plant is 126 kilometers from Shanghai.

Windmills and tidal power generators are mainly installed for people on islands and in remote mountain areas.

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CSO: 4010/14

## POWER NETWORK

### SHANDONG MAKES MARKED PROGRESS IN POWER INDUSTRY

SK080418 Jinan Shandong Provincial Service in Mandarin 2300 GMT 6 Nov 85

[Text] During the implementation period of the Sixth Five-Year Plan, our province has made marked achievements in the power industry. It prefulfilled by 1 year the power output target set forth by the Sixth Five-Year Plan, showing a yearly average increase of 7 percent, and has accelerated the pace of building power plants, showing an increase of 1.2 million kilowatts in installed capacity.

During the past 5 years, Shandong has steadily pushed forward the drive to conduct reforms and improved the quality of enterprises by actively enforcing various economic responsibility systems with the emphasis on signing contracts, thus bringing into play the enthusiasm of the broad masses of staff members and workers in production. In prefulfilling the power output target set forth by the Sixth Five-Year Plan by 1 year in 1984, the province is expected to realize 26.1 billion kWh this year, a 40.3 percent increase over the 1980 figure. All counties, more than 97 percent of the townships, and more than 69 percent of the villages throughout the province now have a power supply.

During the implementation period of the Sixth Five-Year Plan, our province has steadily accelerated the pace of building power plants and supply facilities. It has invested 1.46 billion yuan in the capital construction of power plants each quarter during the past 5 years and successively completed the building of 8 generating units in the power plants of (Shiliquna), (Huangdao), (Huangtai), and Longkou, resulting in an increase of 900,000 kilowatts in installed capacity. During the period, Shandong has built transmission lines exceeding 110,000 volts over an area of 2,783 km, and has realized 1,86 million kilovolt-amperes in power transformation capacity. The province has formed a unified power grid with an installed capacity of 4 million kilowatts. In September 1984, we started to build our first ultrahigh voltage 500 kV power transmission line between Zou County and Weifang, through Jinan, thus indicating that our province has reached a higher level by building such a transmission line. At present, the project of building the transmission line is under rapid construction.

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## POWER NETWORK

### BEIJING'S POWER SUPPLY SAID VASTLY IMPROVED

SK260403 Beijing BEIJING RIBAO in Chinese 28 Sep 85 p 1

[Text] According to statistics, from 1980 to September of this year, the municipal power supply load increased by 380,000 kW, equal to the total power load generated from 1949 to 1963. By the end of this year, the municipality will overfulfill the targets for the maximum power generation--47.79 billion kWh--and the maximum power supply load--1.75 million kWh--originally set by the Sixth Five-Year Plan.

Along with a flourishing economy and the constant improvement of the people's living standards, the power consumption of Beijing Municipality has increased by 100 percent every decade. Without any newly added power generation facilities, the several major power plants in Beijing have, since 1980, vigorously tapped their potential, and overfulfilled the targets every year, thus ensuring the attainment of the state-assigned generation tasks. In order to add the power resources in Beijing and Tianjin, the state has invested in building the Jinghou, Tongji, and Dafang power transmission lines during the Sixth Five-Year Plan period, which have diverted a total of 800,000 kW from Zhangjiakou, Tangshan, and Datong. The Dafang line project is one of the three biggest power systems in the country. Through 4 years of construction, the second Dafang return circuit project was completed on 18 September, has now entered the trial operational stage, and will go into production within this year. After going into production, this circuit will divert 1.5 million kilovolt-amperes from Datong. This project will play a great role in developing the power industrial undertakings in Beijing.

Over the past few years, power supply departments in Beijing have respectively built the Xibeiiao, Fangshan, Qianmen, and Dongbeiwang transformer substations, have expanded the Laojuntang, Balizhuang, and Changping transformer substations, have added the installed transformer capacity by more than 1 million kilovolt-amperes, and have newly built some power transmission lines with a total length of 387 km.

Thanks to the increase of power supply and the gradual improvement of the power supply network, remarkable changes have taken place in the quality of power supply in Beijing during the Sixth Five-Year Plan period. In

the past, abrupt voltage changes were serious, and quality was low, thus adversely affecting the industrial and agricultural production and the people's livelihood. Now, the standard rate of the annual cycle has reached 98 percent or higher, and the voltage is relatively stable. From 1980 to 1984, the rate of power transmission service breakdowns dropped by 0.1 percent annually for each 100 km. The municipal power supply service has basically attained the target of safety and stability.

During the period covered by the Sixth Five-Year Plan, power supply departments have also paid attention to the quality of power supply. From 1980 to 1984, the municipal power consumption volume increased by more than 1.5 billion kWh, while the damage rate of power transmission lines dropped by 1.3 percent, which is equal to conserving 120 million kWh of electricity.

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## POWER NETWORK

### BRIEFS

GUANGXI TRANSMISSION LINE ERECTED--The erection of a 220 kV high-tension transmission line between Heshan, Laibin, and Wuzhou--a key project of the Guangxi and Guangdong joint electric power grid--was recently erected. This high-tension transmission line was erected to speed up the exploitation of the Hongshui He and to transmit electricity from the west to the east. The 490-km-long line begins at Heshan, Guangxi, in the west and leads to Guangzhou in the east. Electricity is transmitted from the Heshan power plant to Wuzhou through Laibin, Guiping, Pingnan, Tengxian, and Cangwu, some 290 km. The project was designed by the Electric Power Survey and Design Institute of the regional Electric Power Bureau and was constructed by the Guangxi Transmission and Transformer Construction Co. The project commenced in September last year. With the completion of this project, a powerful electric current will be steadily transmitted to Guangdong. /Summary/ /Nanning Guangxi Regional Service in Mandarin 1130 GMT 16 Oct 85 HK/12228

ANHUI POWER TRANSMISSION--The 200 kV power transmission line linking Tongling and Wuhu, as well as the Tongling transformer station, was successfully completed and went into operation on 26 September. A total of 184 towers were erected along the 72-km transmission line. The transmission line and transformer station have markedly improved the power supply, and have promoted copper mining and industrial and agricultural development in the areas. /Summary/ /Hefei Anhui Provincial Service in Mandarin 1100 GMT 1 Oct 85 OW/ 12228

ZHEJIANG POWER GENERATION--The combined power output of over 500-kW generators in Zhejiang Province during the Sixth 5-Year Plan period was 51.96 billion kWh, up 25.08 billion kWh from the Fifth 5-Year Plan period. The total installed capacity of over 500-kW hydroelectric and thermal electric generators in the province is expected to reach 3.2 million kW at the end of 1985, 1.5 times as much as 1980. /Summary/ /Hangzhou Zhejiang Provincial Service in Mandarin 1000 GMT 28 Sep 85 OW/ 12228

SHANXI 500 KV LINE--Taiyuan, 17 Sep (XINHUA)--The 500 kV ultrahigh tension power transmission line from Shentou to Datong, Shanxi Province, was completed at 1900 hours on 15 September, 15 days ahead of schedule. A key project, the line is 115 km long, leading from Shentou Power Plant through Shuoxian, Shanyin, and Huaiyuan counties to Datong No 2 Power Plant. Integrated with the 500 kV transmission line from Datong to Fangshan, Beijing, it is expected to transmit 5 billion kilowatt-hours of electricity a year from the Shentou Power Plant to the Beijing, Tianjin, and Tangshan areas, to help alleviate power shortages in the capital.

HENAN DEVELOPS POWER INDUSTRY--According to HENAN RIBAO, during the Sixth Five-Year Plan period, the province constantly developed the power industry. It now has 93 large, medium, and small power stations and 650 large, medium, and small transformer stations. The length of high- and low-voltage cables could circle the earth more than six times. The extensive power supply network, the high parameter, large-capacity generating sets, and the ultrahigh voltage power supply and transformer equipment were the three major signs of the province's power industry development. Some 96 percent of the towns are now supplied with electricity. The installed capacity of small thermal power stations in rural areas ranks first in China. [Summary] [Zhengzhou Henan Provincial Service in Mandarin 2300 GMT 7 Nov 85] /9604

GUANGDONG-GUANGXI POWER NETWORK--The Guangdong-Guangxi power transmission and transformation network project entered its full-swing stage on 8 November. Eight cables cross the Xi Jiang, linking the power networks of the province and the region. It is expected that the project will be put into operation by the end of this month. Guangdong may draw 180,000 kilowatts of electricity daily from Guangxi, easing the province's power supply problems. The network links the (Pinglong) station in Wuzhou, Guangxi, and the (Hongxing) station in Foshan, Guangdong. The 202 transmission towers and 201 concrete pylons from Wuzhou to Zhaoqing have been installed. [Summary] [Guangzhou Guangdong Provincial Service in Mandarin 0400 GMT 8 Nov 85] /9604

GUANGXI POWER DEVELOPMENT--In the Sixth Five-Year period, the Guangxi Region has greatly developed electric power building. The installed capacity of hydroelectric stations and thermoelectric plants which have been put into operation is 585,000 kilowatts. The total length of the 110-kilovolt electricity transmission lines which have been erected is 587 kilometers, and transformer stations of 270,000 kilovolt-amperes have been built. In addition, the reports on the feasibility studies on two large hydroelectric power stations have been examined and approved. [Summary] [Nanning Guangxi Regional Service in Mandarin 1130 GMT 5 Nov 85] /9604

GEZHOUBA-SHANGHAI 500 KV LINE--Wuhan, 25 Oct (XINHUA)--Workers today began installing the first 500,000-volt direct current transmission line between the Gezhouba hydroelectric power station on the Chang Jiang and Shanghai. Stretching from the power station at Yichang, Hubei Province, the 1,080-kilometer line will cross 35 counties and cities before reaching China's largest industrial city. It will have a transmitting capacity of 1.2 million kilowatts of electricity, and is expected to go into operation in 1988. Part of the equipment for the scheme has been imported from the Federal Republic of Germany, Japan, and Switzerland. The high-voltage line will greatly alleviate power shortages in the Shanghai area. [Text] [Beijing XINHUA in English 1831 GMT 25 Oct 85 OW] /9274

HUAINAN-SHANGHAI 500 KV LINE--Hangzhou, 30 Oct (XINHUA)--Coastal Zhejiang Province started construction of a super high-voltage power transmission line last week. The 500 KV transmission line, the first in the province, is part of the 650 km line between Huainan in Anhui Province and Shanghai. Huainan is a coal mining and electricity generating center. Construction of the power transmission line will help alleviate electricity shortages in Shanghai, China's leading industrial city, and in Zhejiang Province. [Text] [Beijing XINHUA in English 1513 GMT 30 Oct 85 OW] /9274

HEILONGJIANG POWER CONSTRUCTION--Harbin, 5 Nov (XINHUA)--Heilongjiang Province, one of China's major industrial centers, is speeding up construction of power stations for faster economic growth. The generating capacity of the northeastern province is now 3,370,000 kilowatts--1,240,000 kilowatts more than 5 years ago, according to the provincial power bureau. Authorities plan to add another 3,600,000 kilowatts of capacity over the next 5 years. In addition, the bureau said, another 3,000 kilometers of high-voltage transmission lines would be erected. The province's gross value of industrial output had increased at an annual average rate of 12 percent over the past 5 years. Approximately 25 million square meters of housing had been built in the province since 1981 to improve people's living conditions, he added. All this growth had placed a heavy strain on the electricity-generating industry, the bureau said. The province had been given a special priority in receiving central government investment for power construction. This priority would remain throughout the next 5 years. The official said more than 1 billion yuan had been invested over the past 5 years for building power stations, erecting high-voltage transmission lines and boosting transforming capacity. The province was also planning to build its first 500kV power transmission and transforming scheme in the next 5 years, he added. [Text] [Beijing XINHUA in English 1300 GMT 5 Nov 85] /9604

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## HYDROPOWER

### ECONOMICS OF HYDROPOWER EVALUATED

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 9, 12 Sep 85 pp 3-9

[Article by the Water Conservancy and Hydropower Planning and Design Commission of the Ministry of Water Resources and Electric Power and the Hydropower Planning and Kinetic Energy Economics Commission of the Chinese Hydroelectric Power Society: "We Should Seek Truth From Facts When Evaluating the Economics of Hydroelectric Power--Some Opinions on the Article 'Re-evaluating the Economics of Hydroelectric Power'"]

[Excerpts] Abstract

The article "A Re-evaluation of the Economics of Hydroelectric Power" (abbreviated below as the "Re-evaluation") lacks an understanding of the real situation in hydropower, uses certain unrealistic figures, and even derives conclusions that do not conform to reality. The actual situation is that a comparison of hydropower with thermal power shows that total investments and construction periods are nearly the same. Equipment used in hydropower has a shorter useful life, but this is not something inherent in it. Instead, it is essential in electric power system operation and regulation. The use of thermal power for load regulation also reduces the useful life of equipment. Long-range transmission of hydropower not only requires less investment than long-distance shipment of coal but also has rather substantial benefits in the area of linked grids. The costs of hydropower remain lower than the costs of thermal power when we calculate the time-value of capital.

The "Re-evaluation" suggests that "if we make an appropriate reduction in the scale of hydropower before the year 2000 and use one-half the investments in hydropower to develop thermal power, we could increase installed generator capacity by 46 million kW and power generation by 275 billion kWh." This is an unrealistic inference and supposition. There is no great difference in the investments required for hydropower and thermal power, and construction periods are about the same. Using investments in hydropower to develop thermal power actually only would increase installed generator capacity by an equal amount, so the question of increasing installed generator capacity is nonexistent. Besides the supposition that one-half of investments in hydropower be taken away, the goal of "increasing thermal power output by 46 million kW and power generation by 275 billion kWh" also would require the consumption of 150 million tons of standard coal, and the state would have to

put up 49.6 billion yuan in investments in the corresponding coal mines and railroads. Not only would this deny the electric power industry an opportunity to catch its breath, it would lead to serious mistakes in energy resource policies.

This is, therefore, a very incautious viewpoint and does not favor national economic construction. The correct path should be to focus on development of hydropower in those regions of China that are rich in hydropower resources. Regions with fewer hydropower resources also should strive to develop hydropower to the greatest possible extent and shift the focus in electric power construction toward hydropower and raise the proportion of hydropower in the electric power industry.

Special issue (1) of "Investment News" published on 10 February 1985 by the Investment Survey Department and Investment Research Institute of the Chinese People's Construction Bank contained the article "A Re-evaluation of the Economics of Hydroelectric Power" which stated that: "Investments in hydropower are double those in thermal power and construction periods are twice as long, the useful life of equipment is reduced by 60 percent. Moreover, there would be major losses in redundant capacity, and the investments to produce an equal amount of electricity using hydropower are four times those in thermal power." "The costs of hydropower are higher than those of thermal power." "Excessive development of hydropower is uneconomical." Moreover, it is proposed that "there be an appropriate reduction in the scale of hydropower and that half of the investments in hydropower be taken out for use in thermal power." "This would give the electric power industry a breather so that it can strive to progress and develop," and so on. We feel that this article lacks a scientific attitude and comprehensive viewpoint of seeking truth from facts, that it lacks any understanding of the characteristics of hydropower, and that it uses certain superficial data to derive a mistaken conclusion. It is quite incautious and dangerous to provide such information to state policy-making departments. The economic qualities and superiority of hydropower are easily seen if hydroelectric and thermal power are analyzed on the basis of seeking truth from facts.

I. When Hydroelectric Power and Thermal Power (Throughout the Process of Energy Resource Input/Output) Are Compared, There Are **no** Major Differences in Total Investments and Construction Periods Are Nearly the Same

Hydropower stations are different from thermal power stations in that hydropower is a renewable energy resource. They use no fuel, whereas thermal power requires the burning of coal and oil, as everyone knows. For this reason, when we are comparing the economics of hydroelectric and thermal power, thermal power must include investments in coal mines and transportation, and investments in hydroelectric and thermal power transmission also should be considered. Just as Vice Premier Li Peng [2621 7720] pointed out in the first meeting in October 1983, electric power construction must make a comprehensive comparison that includes coal, electricity, shipping, and power transmission. If we depart from this principle and only compare the cost per kW for hydroelectric and thermal power, the results will not reflect

the original state of affairs. The basic state of affairs should be that:

1. The ratio of total investments in hydropower and thermal power is 1:1 (2,070:2,015 yuan).

An analytical comparison of total investments at the present time should begin with the regional distributional characteristics of China's developable hydropower and coal resources in the short run and the actual conditions in electric power planning prior to the year 2000 and use them to calculate the investments in power stations and the corresponding power transmission, as well as in coal mine and railroad construction, then the cost is 2,070 yuan/kW for hydropower (1,500 yuan for the power station and 570 yuan for power transmission) and 2,015 yuan for thermal power (800 yuan for the power station + 478 yuan for the coal mine + 737 yuan for railroads).

The above figures do not take into consideration the investments in power transmission for thermal power. If we calculate the investments in power transmission, the investment in thermal power per unit kW are even higher. The "Re-evaluation" also calculates the corresponding investments per kW for hydroelectric and thermal power. When estimating the corresponding investments in coal mines and railway transportation, however, it adopts figures that even coal departments consider low. The article, for example, calculates the total investments for construction of a coal mine at 120 yuan per ton of coal. The contractual responsibility index used in the Ministry of Coal [Industry], however, is 175 yuan/ton. The distance of "shipping western coal to the east" is assumed to be 1,000 kilometers. The distance involved in shipping coal from Shanxi to central loads is far greater than this figure, however, being 1,650 kilometers from Taiyuan to Shanghai, 1,480 kilometers from Changzhi to Changsha, and 2,166 kilometers from Changzhi to Guangzhou. It can be seen that a figure of no less than 1,500 kilometers should be used to estimate the distance required to transport the coal.

In another area, the "Re-evaluation" also uses figures that are too high when calculating the total investments for hydropower. The article states that "China's hydropower resources are located in the far-off Qinghai, Xizang, Yunnan, Guizhou, and Sichuan regions..., 'sending western electricity to the east' involves transport distances that are much greater than those for 'shipping western coal to the east.'" This is not the actual situation at present. According to state plans, the focus of hydropower development prior to the year 2000 is in the upper reaches of the Huang He (below Longyangxia), Hongshui He, and the main trunk of the middle and upper reaches of the Chang Jiang. The main places that have a need for "sending western electricity to the east" are the Gezhouba, Sanxia [Three Gorges], and Hongshui He cascades, and the farthest distance that power would have to be transmitted is 1,000 to 1,100 kilometers. Moreover, most of the hydropower stations to be built before the year 2000 will be utilized locally, so the distance that power would be transmitted is much smaller than this. For this reason, the transport distances in the short run for "sending western electricity to the east" are shorter than those for "sending western coal to the east," and the state's investment would be less.

Moreover, the construction of high voltage power transmission lines to "send western electricity to the east" will expand linkages between power grids and bring enormous economic advantages in such areas as compensation for runoff electric power between hydropower stations, system crossloads, and conservation of reserve capacity. For example, after the power transmission line from Gezhouba to Shanghai goes into operation, the benefits from linked grids will reach 1 million kW and make it possible for Gezhouba to utilize discarded water to generate an additional 500 to 600 million kWh in hydroelectric power. The investment in the first period of the North China Power Transmission Project for the hydropower base area in the upper reaches of the Huang He is 1.2 billion yuan. Benefits from linked grids in 1995 would be 2.17 million kW (including 1.49 million kW from regulation of hydropower utilization and 680,000 kW from crossloading). There would be a 1.3 billion yuan reduction from the 2.5 billion yuan total investments in single operation of two grids. Linked grid operation can make use of the hydroelectric and thermal power advantages of different regions and obtain enormous joint economic results. The "Re-evaluation," however, includes all investments in power transmission in the investments related to hydropower but does not consider the economic benefits from linked grids, so it obviously is irrational.

It also should be pointed out here that hydropower stations usually have comprehensive benefits in such areas as flood prevention, irrigation, shipping, breeding, and other things. Many reservoirs have reduced the danger of flood disasters after they were completed, and they have improved river transport capacities. Some have built fishery base areas and tourist regions, some are providing water to industry and agriculture, and so on. For this reason, some foreign nations practice rational investment sharing for hydropower construction and generally can share out 20 to 30 percent of investments for key hydropower projects. China's "big common pot" management and administration system of the past, however, did not practice rational investment sharing. Reforms in economic systems have made investment sharing for hydropower essential. This can reduce investments in hydropower by 300 to 400 yuan per kW. In contrast, the need for environmental protection for thermal power has increased the proportion of expenditures on environmental protection to 20 to 30 percent of basic investments in thermal power plants. The ever higher environmental protection requirements, moreover, have increased expenditures on equipment for thermal power generators, and they have increased investments per kilowatt substantially. Investments in the Shiheng thermal power station itself now have reached 1,026 yuan/kW, and they are 966 yuan/kW at Dawukou and 1,719 yuan/kW for the expansion at Yaomeng (including 1,100 yuan/kW for generator equipment). All of these facts prove that investments in thermal power stations are much greater than the 800 yuan/kW used in the "Re-evaluation." This is not mentioned in the "Re-evaluation," however.

2. When coal mine construction is included in thermal power, the construction periods for hydroelectric and thermal power are about the same.

The "Re-evaluation" states that "hydropower takes a longer time to build and that "hydropower averages 8 years, while thermal power averages 4 years."

This is actually the case when we consider only the construction of a power station project itself, but the question is not so simple. It was mentioned above that thermal power plants cannot generate electricity as soon as they are completed like hydropower stations can. This is especially true given the current situation of extreme shortages in coal supplies, communications, and transportation. When a large number of thermal power stations are constructed, the construction time required to achieve power generation actually is controlled by the construction times required for coal mines and railroads. A 3-million-ton [annual output] mine generally takes an average of 7 years to complete, and about 10 years are needed to build 1,000 kilometers of new railroad. These figures are no better than the 8-year average construction period required for hydropower stations. A comprehensive comparison of hydroelectric and thermal power, therefore, shows that nearly equal amounts of time are required for construction.

It can be seen that by starting from reality and using scientific analysis to make a comprehensive comparison that links coal, electricity, shipping, and power transmission together, it is obvious that there is no substantial difference in the cost per kilowatt for hydroelectric and thermal power construction, and that they have nearly equal construction times. The statement that "investments and construction times are doubled" does not conform to the objective real situation.

## II. After the Time-Value of Capital Is Considered, the Cost of Hydroelectric Power Is Lower Than that of Thermal Power

The "Re-evaluation" article points out that "the costs of hydropower are not low" and that "the cost of hydropower is 4.36 percent higher than thermal power." This, likewise, does not conform to reality, and the conclusions that are drawn as a result are mistaken.

First, we can use actual statistical data to show this. According to actual statistics (not including profits) for the electric power industry, the cost of thermal power is 2.75 times higher than hydropower. This can be proven.

The "Re-evaluation" uses a cost calculation method that includes profits. Besides the fact that only the costs of hydroelectric and thermal power themselves are calculated and that the corresponding expenditures on power transmission lines, coal mines, and railroads are not included in the calculations, the primary reason for the conclusion that "hydropower costs 4.36 percent more than thermal power" is that it also uses certain unrealistic figures. For example:

1. Coal prices and coal consumption are too low. It uses an FOB price for coal of \$36 per ton, which actually is too low. A 1985 survey indicates that the actual FOB price for coal is more than \$40 per ton. Actual coal consumption for power generation now is 398 grams/kWh, and the plan is for 375 grams/kWh by 1990. The "Re-evaluation" uses 330 grams/kWh, however, which is 17.1 percent lower than actual coal consumption at the present time and 12 percent lower than the planned coal consumption index for 1990.

2. A constant 1.43 percent expenditure rate for major repairs is used, which obviously is too high for hydropower. The large dams and other hydro project facilities at hydropower stations are not easily worn, and the generator inspection and repair period is rather long. Actual expenses on major repairs are very low. The actual rate of expenditures on major repairs is only 0.5 percent at the Xin'an Jiang and Fuchun Jiang hydropower stations, for example. The "Re-evaluation," however, derives the cost of major repairs from the original value of fixed assets. Because of the large foundation of hydropower stations, the expenditure rate thus derived gives a cost of major repairs for hydropower of more than 0.01 yuan/kWh, which is equal to the average cost of hydropower at the present time. This method of calculation obviously is irrational.

3. The circulating capital for hydropower is too high. The "Re-evaluation" adopts a figure of 30 yuan per kW of circulating capital for both hydro-electric and thermal power, which is too high for hydropower. Hydropower requires few products and parts, and it needs no fuel, so the amount of circulating capital actually is much less than thermal power. Analysis indicates that circulating capital is 8 yuan/kW for hydropower and 45 yuan/kW for thermal power. The figure is 2 yuan/1,000 kWh for hydropower and 11 yuan/1,000 kWh for thermal power.

Based on the above real circumstances, we also considered the time-value of capital and used an annual profit rate of 10 percent. The result was that the cost per 1,000 kWh was 86.4 yuan for hydropower and 116 yuan for thermal power, so thermal power was 34.3 percent higher than hydropower.

In light of the above reasons, we feel that hydropower deserves development because the costs of hydropower are lower than those of thermal power. China's irrational energy resource prices at the present time have not been sufficiently rational when making comparisons of the economy of hydroelectric and thermal power. The price of coal is too low and thus cannot reflect realistically the difference between hydroelectric and thermal power operating costs, so it objectively is not conducive to hydropower development. Future readjustment in energy resource prices, however, will result in a tendency for the cost of thermal power to rise. All thermal power stations built after 1984 have to burn negotiated price coal, which will raise the cost of thermal power even higher. Once a hydropower station is completed, however, it can be operated at low cost for a long period (hydropower does not burn fuel, while fuel costs account for about 70 percent of the cost of thermal power), so the economic benefits of hydropower are quite obvious.

III. The "Re-evaluation" States that Hydroelectric Power "Has Great Losses From Redundant Capacity," Which Is a Wholly Mistaken Conclusion Due to a Mistaken Viewpoint

The "Re-evaluation" mistakenly interprets redundant capacity as being equivalent to a reduced ability of installed generator capacity to guarantee output (average daily output during the dry season) and states that "guaranteed output of hydropower generally is only about one-third of installed generator capacity, and it is very unstable and requires the redundant

installation of a certain amount of installed generator capacity, which is redundant capacity." What is this redundant capacity of hydropower? The real meaning is the reduction in required capacity for installed generator capacity. The required capacity is equivalent to working capacity added to various types of reserve capacity and is determined according to the amount of guaranteed hydropower capacity, the quality of reservoir regulation capabilities, the shape of system load curves, the working position of the power plant within the system, and other factors through balanced electrical power output and economic comparisons. The difference between a good regulation capacity of hydropower stations and a poor regulation capacity is that there is no redundant capacity in the former and that redundant capacity is installed in the latter case only when there are favorable economic conditions, so there is no question of "great losses."

If hydropower accounts for a small proportion of an electric power system and the system has a hydropower station with rather good regulation capabilities, then hydropower should be responsible for load regulation. The ratio between installed generator capacity and guaranteed output is greater and the utilization time is lower, but there is no redundant capacity. The Xin'an Jiang hydropower station, for example, has a long-term regulation reservoir capacity. It has an installed generator capacity of 662,500 kW, generates 1.86 billion kWh per year, and has a guaranteed output of 178,000 kW. If we accept the view of the "Re-evaluation," however, this hydropower station would have less guaranteed output (only one-fourth installed generator capacity) and low equipment utilization time (2,800 hours), so the economic results would be very poor. The facts are just the opposite, however, Reservoir regulation means that there is no great difference in output during the wet and dry seasons at the Xin'an Jiang hydropower, and it concentrates its 24-hour-a-day continuous guaranteed capacity for use during the hours of peak system loads, thereby providing several times the working capacity of guaranteed output. Although guaranteed output is only one-fourth of installed generator capacity, all of the generators are needed by electricity users, so there is no question of "redundant capacity." It now is the main load regulation power station in the East China Grid. Other such examples can be found at Baishan (2,220 hours), Dongjiang (2,640 hours), Xinfeng Jiang, and other hydropower stations.

If hydropower accounts for a larger proportion of an electric power system and the regulation capabilities of the hydropower are rather poor, more "redundant capacity" can be installed to make use of the large amount of seasonal electricity. Gezhouba, Gongzui, Dahua, and other hydropower stations are runoff power stations with rather poor regulation capabilities. In order to make the fullest of their hydropower resources, generate more electricity during the rainy season, and conserve on coal consumption, the size of this "redundant capacity" is determined by the amount of economic benefits. The redundant capacity at Gezhouba, for example, generates 3.8 billion kWh of electricity each year, which can conserve 2.2 million tons of coal. It should be explained that with the continuous development of hydropower cascades and the development and expansion of power grids, and when there are a few runoff power stations with reservoirs having good regulation capabilities in the upper reaches, the degree of runoff regulation will be raised,

and some redundant capacity will be converted into working capacity, which will provide even greater economic results.

Furthermore, if hydropower accounts for a large proportion of an electric power system and if the hydropower stations have good load regulation capabilities, then they can bear basic loads as well as peak loads, which also could increase the number of hours the installed generators are utilized, so there would be no redundant capacity. At the Longyangxia hydropower station, for example, the power plant has 1.28 kW in installed generators, generates 6.03 billion kWh of electricity a year, and has a utilization time of 4,710 hours.

We can see from the above that there is no "redundant capacity" at power stations with good regulation capabilities and that the installation of redundant capacity at power stations with rather poor regulation capabilities has advantages as well as disadvantages, but the good outweighs the bad. The suggestion that "there will be major losses due to redundant capacity" is the result of an erroneous viewpoint.

#### IV. The Main Reason for the Low Hours of Utilization of Hydroelectric Power Compared With Thermal Power Is That It Is a Requirement of Economical Operation of Electric Power Systems

The "Re-evaluation" maintains that "China has a monsoon climate and the utilization time of hydropower equipment is low, averaging only 3,500 hours, which is 2,000 hours less than thermal power and equivalent to a 36 percent reduction in the amount of electricity generated." This is due to a lack of understanding concerning power network dispatch operations. Changes in load within a grid require some power stations to bear basic loads, while others are responsible mainly for peak loads, peak regulation, frequency regulation, and accident reserves. The fact that thermal power generators are slow to start up means that they take 5 to 10 hours to go from a heated reserve state to full load, while hydropower generators only take 2 or 3 minutes. Moreover, several tens of minutes are required for thermal power generators to go from reserve rotation to full load operations. Moreover, the generators are started and stopped frequently, which reduces their useful life and increases coal and oil consumption. In order to improve the reliability of electric power system electricity supplies and the quality of the electrical power as well as reduce coal consumption, hydropower plants usually are allowed to bear load regulation, frequency regulation, and accidental reserves. This is an essential condition for safe and economical operation of power grids and illustrates precisely the advantages of hydropower. The hours of equipment utilization in peak regulation power stations should be low, and the situation is the same when thermal power is used for peak regulation. Hydropower accounts for a small proportion in the East China Power Grid. Two imported 320,000 kW oil-burning generators are used at the Dagang power plant for peak regulation throughout the year. They are silent during most hours of the day and are started up only during peak use periods. The frequent changes and unevenness of electric power system loads objectively require the installation of fairly flexible generator power sources like hydropower stations, water lifting reserve energy power

stations, gas-burning generators, and so on. It certainly is not China's monsoon that reduces the utilization time of hydropower station equipment. Many nations in the world have constructed a large number of water lifting reserve energy power stations to regulate peaks and valleys and achieve safe and economical operation. They trade 3 kWh during load valley periods for the ability to bear 2 kWh during peak loads. This has arisen from the development of science and technology, and it has broadened everyone's views concerning the realm of economic results and added a means to create value.

China's hydropower equipment is used for an average of 3,500 hours, the figure in large- and medium-scale power stations being more than 4,000 hours. This is rather high in world terms, higher than the United States, the Soviet Union, Japan, West Germany, and most other countries. It is only lower than DPRK, Canada, Brazil, and a few other nations where hydropower is dominant.

#### V. We Should Strive To Develop More Hydroelectric Power in Regions With Abundant Hydropower Resources and Do a Good Thing for Future Generations

To guarantee that the total value of industrial and agricultural output is quadrupled by the year 2000, the electric power industry must at least quadruple [output]. Installed generators must reach 250 to 270 million kW, and annual power output must reach 1.2 to 1.3 trillion kWh. Of this amount, coal-fired power must provide about 900 million to 1 trillion kWh, which will require the burning of 470 to 525 million tons of coal. National plans are for coal output to reach 1.2 billion tons in the year 2000, an increase of 600 million tons in 20 years. Coal used for electrical power production, however, accounts for 18 percent of total coal output and will rise to 39 to 44 percent by 2000. This is equivalent to more than 70 percent of the state's unified distribution coal and also means that 78 to 88 percent of increased coal output must go for thermal power. The possibility of this happening awaits study. China leads the world in hydropower resources. The development and utilization rate is low, only 4.5 percent when calculated in terms of electrical power. Many nations in Europe and the United States were the first to develop hydropower, and the degree of hydropower utilization has surpassed 40 percent. Some have reached 70 to 80 percent or more. China should strive to develop more hydropower as quickly as possible and at least quadruple it by the year 2000 by reaching 80 million kW, an increase of 60 million kW in new installed generator capacity.

Leading comrades in the CPC Central Committee and the State Council are giving a great deal of attention to speeding up construction of hydropower. When he was visiting the Baishan power station, CPC Secretary Hu Yaobang offered the inscription "China ranks first in the world in hydropower energy, the power industry should lead the way to the four modernizations." Premier Zhao Ziyang pointed out with extreme interest while hearing a work report from the former State Energy Resource Commission that "the energy question in the long term requires China to develop more hydropower. The advantages are too great, and we also are giving our future generations something good. Hydropower is not the same as coal and petroleum. Hydropower is a renewable energy resource, not a primary consuming energy resource, and it does not

pollute, so it should be handled as a strategic measure. The nations of Europe and the United States have developed hydropower to a very high level. China has such excellent hydropower resources. We must overcome some difficulties each year and squeeze out some investments for hydropower, even to the point where it affects everything else, and the principles and policies should be implemented through annual plans. There can be visible results in a decade and major changes in two decades. We should have a strategic viewpoint here and should not waste time year after year whenever difficulties are encountered. When we look back from the future, we will have committed a great error."

Premier Zhao's instructions have outlined clearly the importance and superiority of developing hydropower. The "Re-evaluation," however, lacks a strategic perspective and proposes superficially that investments in hydropower be reduced to develop thermal power. Our previous analysis permits us to learn that the fact that over-all investments are not substantially different and that the construction times are nearly the same means that a reduction in hydropower would not increase installed capacity, so the actual installed capacity would be the same. If the ideas in the "Re-evaluation" were feasible, then why only "take out one-half the investments in hydropower?" Wouldn't it be even better to cut out all investments in hydropower? The "Re-evaluation" feels that merely by "taking out one-half the investments in hydropower" it would be possible to "increase thermal power by 46 million kW and electricity output by 275 billion kWh." This is a totally unrealistic hypothesis. Our estimates indicate that in reality, besides one-half of the investments in hydropower, it also would require an additional 150 million tons or so of coal, and the corresponding investments in additional coal mines and railway transport would reach 66.75 billion yuan. Even if we deduct the 17.1 billion yuan in corresponding investments for power transmission lines for hydropower, the state still would have to provide 49.6 billion yuan. This is neither realistic nor economical, and there is no way that it would "provide an additional 180.0 billion yuan in revenues to the state." Therefore, this theory as proposed in the "Re-evaluation" inevitably would result in substantial mistakes in policy making.

The goal of hydropower station construction is to use river water--water that flows unused into the sea year after year--to generate electricity. It requires no burning of coal or oil. Hydropower is a renewable energy resource, and hydropower stations can be utilized for a long time after they are completed. This is their basic difference from thermal power stations, in that they can conserve large amounts of coal and petroleum and create wealth for our future generations. We feel that policy-making related to electric power industry construction should take into consideration the structure of energy resources in China, the economic benefits of combining hydroelectric and thermal power and the realities of electric power construction over the past 30-plus years, as well as both positive and negative experiences that we already have accumulated and other things. It seems that the "Re-evaluation" is concerned only with the current investment difficulties and superficially stresses more construction of thermal power. In reality, this is detached from China's national conditions and repeats past mistakes of "cooking a meal without rice."

The basic reasons for the inadequate electricity supplies in China at the present time are insufficient state investments and irrational systems. Accumulation in the electric power industry is used to support electricity-consuming activities, which has made the problem of inadequate investments in hydropower even more acute. Irrational electricity prices in effect for years maintain a single price for peaks and valleys in hydroelectric and thermal power and have led to "big common pot" accounting, which has concealed the superiority of hydropower and obstructed its development. For this reason, we should squeeze out some more investments in thermal power like so many other nations in the world have done and adopt policies to develop hydropower and expand it more. Otherwise, the result would be as Premier Zhao Ziyang has pointed out, that "by wasting time, when we look back in the future, we will have made a big mistake." The problem of a shortage of electrical power at that time inevitably will hold back the four modernization drives.

12539/13046  
CSO: 4013/10

## HYDROPOWER

### PROPOSED CASCADE DEVELOPMENT FROM LONGYANGXIA TO LIUJIAXIA

Beijing SHUILI FADIAN [WATER POWER] in Chinese No 8, 12 Aug 85 pp 3-5

[Article by Shi Ruifang [4258 3843 5364] of the Northwest Survey and Design Academy of the Ministry of Water Resources and Electric Power: "Some Opinions on Cascade Development in the Longyangxia-to-Liujiaxia River Section"]

[Text] The Longyangxia-to-Qingtongxia section in the upper reaches of the Huang He is a "motherlode" of hydropower resources. The Longyangxia-to-Liujiaxia section within Qinghai Province is a "motherlode" within the "motherlode." Some 63 percent of the drop in the Longyangxia-to-Qingtongxia section is concentrated in the section, accounting for three-fifths of total electricity output. Achievement of cascaded flow in this section of the river could greatly reduce project costs, shorten construction timetables and provide enormous technical and economic results. For this reason, the author will give a simple description of this problem and offer some opinions to provide a reference for leaders at higher levels and in policy-making departments.

#### I. Favorable Conditions

1. Longyangxia can serve as a "spigot" reservoir [first reservoir in a cascade]. The Longyangxia reservoir can regulate 19.35 billion cubic meters in reservoir capacity after it is completed, and it can serve as a "spigot" through reservoir regulation and provide the obvious benefits of power generation, flood prevention, irrigation, and so on. In the area of power generation, besides the installed capacity of 1.28 million kW and annual power output of 6 billion kWh, regulation by the Longyangxia reservoir could raise guaranteed output by 265,800 kW in the four completed power stations at Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia, and increase their annual power output by 457 million kWh. Furthermore, the five power stations within Qinghai Province at Laxiwa, Liji Xia, Gongboxia, Jishixia, and Sigouxia have a very high guaranteed output and can play their role faster and better if given preferential selection for development. Moreover, the fact that there is no major trunk flow from the Longyangxia-to-Liujiaxia section into the Huang He means that the flow regulation role of the Longyangxia reservoir could be reduced by about 40 percent for floodwaters reaching the design for floods encountered once every 1,000 years. This would permit a corresponding 15 to 20 percent reduction in investments for

flood spillway facilities at the various power stations on this section of the river. This provides favorable conditions for construction of these power stations as soon as possible.

2. Extremely small losses due to inundation. Because of the alternating gorges and plains in the Longyangxia-to-Luiji Xia section, full utilization of the concentrated drop in the gorge sections and preservation of the plains land would greatly reduce inundation losses. Apart from a certain price that must be paid for Longyangxia, the inundation losses at the other power stations would be among the lowest in China. The five power stations besides the one at Longyangxia would have a total installed capacity of 6.7 million kW and would inundate only 18,500 mu of land and displace over 13,800 people. Among them, the Laxiwa power station could use about 40 kilometers of concentrated flow and steep incline to obtain a concentrated head of 220 meters while flooding only a single production team of 150 people.

3. Favorable natural conditions. The topographic, geological, hydrological and other natural conditions are extremely favorable for power station construction. The dam sites at Longyangxia, Laxiwa, and Gongboxia are formed of granite, Liji Xia is diorite, Jishixia is quartz sandstone and Sigouxia is gneiss. Seismic intensity is relatively low. Moreover, the dam sites are gorges and the riverbed cap is very shallow (generally 3 to 5 meters) and suited to construction of arch dams, integral gravity dams, earthen dams or other types of dams and the total amount of engineering involved cannot be considered great. Nearly all the power station dam sites could select outlets in the gorges and can use the broad plains after exiting the gorge as a construction base area. There are rich sand and rock resources and transport distances are not great. Furthermore, the amount of water is stable, and floodwater flows and silt content both are relatively low, which is another advantage. At the Longyangxia cross-section, for example, the long-term average peak flood flow rate is only four times the long-term average flow and the peak flood flow rate for a flood of a severity encountered once every 1,000 years is only 10 times the long-term average flow rate. This is much better than certain river basins in the Chang Jiang system with figures of 20 to 60 times [average flow rates]. The question of flood drainage is solved rather well and it also is fairly easy to deal with silt problems. The most favorable is that construction of the Longyangxia reservoir can permit Longyangxia's "assistance" in temporary flood regulation to be used during construction of the five downstream power stations at Laxiwa and other places, and the diversion and flow cutoff projects will be quite easy. This would lead to an obvious reduction in project costs and shorten construction timetables.

4. The ease of communications with the outside can shorten construction preparation times. The Shaanxi-Haizhou railway runs along the Huang Shui directly to Xining, which is connected by highway to all the dam sites. Only a widening of the roadway would be required when power station construction is underway. The area is located on the Qinghai Plateau and has very little precipitation, so basically no large bridges would have to be built along the roadways. When the decision is made to construct a power station, on-site preparation engineering can get underway immediately. The diversion

projects at each of the dams are basically identical and are both simple and economical. A single 600- to 900-meter-long diversion tunnel and upstream and downstream weirs can withstand flood prevention standards of 20 to 50 years severity. Construction on the base pits of the large dams can be carried out year-round.

5. Superior technical and economic indices. The attached table shows an outline comparison of the 15 cascades in the Longyangxia-to-Qingtongxia section according to three sections of the river.

Table 1. Outline Comparison of the River Sections in the Longyangxia-to-Qingtongxia Section of the Huang He

River section and cascades	Maximum head used (m)	Total installed generator capacity (million kW)	Annual power generation (billion kWh)	Total investment (billion yuan)	Investment per unit kW and per unit kWh (yuan/kW) (yuan/kWh)	
15 cascades from Longyangxia to Qingtongxia	1,073	12.50	50.06	14.134	1,134	0.282
6 cascades within the Longyangxia-to-Liujiaxia section (Longyangxia, Laxiwa, Liujiaxia, Gongboxia, Jishixia, etc.)	661	8 ( $\approx$ 9)	30	8.8	$\approx$ 1,000	0.27
Already-built 4 cascades at Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia	194	1.964	9.74	1.18	500-600	0.12
3 cascades in the Gansu Ningjiangyuan to Daliushu river section (Daxia, Xiaoguanyin and Daliushu)	170	$\approx$ 2.30	$\approx$ 9.5	3.0	$\approx$ 1,300	$\approx$ 0.3

The table shows that the combined installed capacity of the six cascade steps in the Longyangxia to Liujiaxia section could reach 8 to 9 million kW, with annual power output of 30 billion kWh, equal to 60 percent of the 50 billion kWh in the Longyangxia to Qingtongxia section. The unit investment per kW is about 1,000 yuan and the investment per unit kWh would be about 0.27 yuan. Readjustments in material prices make the economic indices slightly higher on the surface than those for the four power stations constructed during the 1970's at Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia. If we calculate according to constant prices, however, they are not that much higher, and the technical and economic indices are superior when compared with current hydropower stations in China at the present time

(which usually require unit investments of 1,500 to 1,800 yuan per kW and 0.40 to 0.50 yuan in investments per unit kWh).

6. Experience already has been accumulated in construction of power stations on the Huang He. Four large- and medium-scale power stations already have been built at Liujiaxia, Yanguoxia, Bapanxia, and Qingtongxia and rich experience has been accumulated in surveying, design, scientific research, construction, manufacturing, operations and other areas. The Liujiaxia station was the largest hydropower station to go into operation in China in the 1970's. The dam now under construction at the Longyangxia hydropower station is 178 meters tall and [the station] has an installed generator capacity of 1.28 million kW. Each generator has a capacity of 320,000 kW and the power is transmitted at 330 kV. Construction of these power stations has provided valuable experience and laid an excellent foundation for sustained comprehensive development of hydropower energy resources in the Longyangxia-to-Liujiaxia section.

7. Fairly intensive preliminary work already has been done. Planning, exploration and design work in the Longyangxia-to-Liujiaxia section of the Huang He began in the early 1950's and there have been many surveys and readjustments of the site selections and plan layouts for the hydropower stations. Besides the four cascades completed and one cascade under construction in the 15 cascades in the Longyangxia-to-Qingtongxia section, designs have been completed for the two stations at Daxia and Lijiaxia. Some exploration has been done at the five stations at Laxiwa, Gongboxia, Jishixia, Xiaoguanyn, and Daliushu and feasibility reports or preliminary designs have been planned for them in 1986 and 1988. Only at the three medium-scale power stations at Siguoxia, Xiaoxia, and Wujinxia has no preliminary exploration been done.

## II. Some Opinions

An optimum cascade development layout is a prerequisite for accelerated hydropower development. Experience in cascade flow developed already has been gained through practice at Liujiaxia, Yanguoxia, and Bapanxia on the Huang He, and it can be extended to the Longyangxia-to-Liujiaxia section. I propose the following opinions to achieve better cascade flow development in the Longyangxia-to-Liujiaxia section:

1. Do more good preliminary work. The Northwest Survey and Design Academy has completed a cascade development plan for the Longyangxia-to-Liujiaxia section, and it is engaged in preliminary design and prospecting at Laxiwa, Lijiaxia, Gongboxia, and Jishixia. The feasibility study report for the Lijiaxia station was examined and approved in 1983, the preliminary design was completed in 1984, and it has been examined and approved. Submission of a feasibility study report for Laxiwa is planned for 1986, and the feasibility reports for Gongboxia and Jishixia will be completed in 1986 and 1988, respectively. The successive completion of these reports can create the prerequisite conditions for cascade flow development.

2. A centralized and unified production base area should be set up for each cascade in Qinghai to form a construction deployment with four

"unifieds": 1) A unified production and living rear base area. Construction of this base area is planned in the area between Xining and Ping'anyi, and management organs, schools, employee residences, comprehensive processing plants, machinery repair and parts plants, transshipment stations, equipment storehouses and other facilities will be built there. This will reduce the amount of temporary facilities, workers dormitories and so on at the main site to a minimum. This can shorten greatly the preparation period and construction schedules, and it will save nearly 200 million yuan in investments. 2) Unified direction of construction contingents. With the current Fourth Engineering Bureau of the Ministry of Water Resources and Electric Power as the foundation, and based on construction procedures and taking the power station as a unit, establish subsidiary construction companies under unified direction but with independent administration. At Longyangxia, for example, there is a peak in concrete pouring at the present time, so excavation forces can be shifted to Lijiaxia to prepare for construction. When the generators at Longyangxia are installed and go into operation, construction of the main body of the project at Lijiaxia can get underway, and preparations for construction can begin at Laxiwa or Gongboxia. This method could reduce the average construction period for each power station to around 5 or 6 years, with obvious and substantial economic results. 3) Unified construction of mechanized equipment. More than 200 million yuan was invested in equipment at Longyangxia. When it is transferred to construction at Lijiaxia, only some of the easily-worn equipment will have to be replenished or replaced. Most of the original equipment can be depreciated and used. By using the original workers with the original machinery, they will operate it well and thereby improve work efficiency and economic results. 4) Unified planning of the "three connections to the outside" (highway communications with the outside, power supply systems coming in from outside, and systems for reporting to the outside). While communications with the outside are taking shape at Lijiaxia, the main communications trunks at the four other cascade steps also can continue to take shape, and the "three connections to the outside" can be formed rather quickly. In addition, there can be corresponding planning and research on two power transmission corridors for sending power eastward: one is the Huang Shui plain corridor, while the other is the transmission line that links the power stations along the Huang He and connects them with the outside. If we deploy according to the plan outlined above and achieve the four "unifieds," rough preliminary statistics indicate that overall investments in the five power stations listed above could be reduced by more than 10 percent and the unit investment per kW could fall to below 900 yuan/kW. Moreover, the period of construction up to the time that the first generator at each power station starts operation could be reduced to around 6 years.

3. Plans and calculations for cascade flow development. I propose that the Lijiaxia power station be selected to follow the Longyangxia power station. A unified production and living rear base area can take shape when the Lijiaxia power station is built. This would permit formation of a construction company with subcompanies having contractual responsibilities set up under it that can achieve cascade flow development, and it can form a main trunkline for the "three connections to the outside" based on the trunk communications

highway. This will lay a foundation for flow construction at each power station. It would be best if Laxiwa follows Lijiaxia. The three power stations at Longyangxia, Lijiaxia, and Laxiwa would have a total installed generator capacity of 6 to 6.5 million kW and annual power output of 22 billion kWh, equal to more than 70 percent of the amount from Qinghai's the six power stations, so the economic benefits are obvious. Furthermore, experience in construction accumulated at Longyangxia and Lijiaxia followed by the building of Laxiwa can provide even greater technical and economic benefits. After the Laxiwa power station, there can be flow development of Gongboxia, Jishixia, and Sigouxia. Based on their terrain and geological conditions, we can do active research on local materials for the dam to reduce the amount of cement used and the amount of shipping to the outside for concentrated development of cascades.

4. Deployment and development of the Lijiaxia power station should proceed as quickly as possible. In its preliminary design, Lijiaxia has become a prime example of a program to reduce project investments and shorten construction schedules. 1) The adoption of a key program for a concrete arch-type gravity dam with plant buildings behind the dam (three generators) and underground (two generators) will reduce the amount of riverbed excavation for the large dam and the amount of concrete required, which can aid in speeding up the base pit project. 2) The water intakes for the two underground generators will be placed below an elevation of 2,125 meters, which is 20 meters lower than the water intakes for the generators behind the dam. This not only is favorable for deployment of the water diversion channels for the underground generators, but also will provide the prerequisite conditions for generating power ahead of schedule. Estimates are that the two underground generators can be put into operation when 65 percent of the total amount of the large dam project is finished and when 75 percent of the investments have been completed. It is predicted that by the time the Lijiaxia power station is completed in its entirety, the two underground generators would have been in operation for more than 2 years and could have produced 7 to 8 billion kWh or electricity. Calculated at 0.065 yuan/kWh, the benefits would be more than 450 million yuan. 3) The construction time for the plant building behind the dam is slower. The generator set aside as No 5 can be placed in position No 5 behind the dam, which will aid in filling in gaps in the work schedule. 4) The upstream Longyangxia reservoir can be used for flood regulation and filling in gaps in diversion measures to reduce the cross-section of the diversion tunnels and reduce problems in flow blockage and current cutoff, which also will improve flood prevention standards while Lijiaxia is being built and guarantee year-round construction of the base pit at Lijiaxia.

After the above measures are adopted, total investments at Lijiaxia could be reduced from the 1.75 billion yuan in the feasibility report to the current preliminary design of 1.66 billion yuan. Installed generator capacity during the later periods could be increased to 2 million kW, so comprehensive technical and economic results could be obtained.

[Summary]

The Northwest has rich hydropower resources, and the only shortcoming is the lack of a concentrated electricity-consuming industry in the Northwest. We should, therefore, speed up research on various programs for "sending western electricity to the east." When the aluminum smelting industry, a "power tiger" [large electricity consumer], is brought in, northwestern hydropower should be connected with northwestern thermal power to gradually link up a unified grid with northern China and other areas. Furthermore, besides the advantages of developing the Longyangxia-to-Liujiaxia section, development of hydropower in the upper reaches of the Huang He should give active consideration to the Jingyuan-to-Daliushu section of the river between Gansu and Ningxia and focus on completion of preliminary work and preliminary designs for this section of the river. This is another question and will not be dealt with in this article.

12539

CSO: 4013/178

## HYDROPOWER

### CONSTRUCTION OF LONGYANGXIA 'IN FULL SWING'

LD160410 Beijing XINHUA in English 0935 GMT 15 Nov 85

[Text] Xining, 15 Nov (XINHUA)--Construction is now under full swing on Longyang Gorge Hydropower Station on the upper reaches of the [Huang He], the second largest in China, after the Gezhouba project on the [Chang Jiang].

The 1,140-meter-long concrete dam for the station, about 100 kilometers southwest of this provincial capital of Qinghai, has reached a height of 105 meters.

With a design height of 178 meters, the dam will be the highest of its kind in China, project officials told XINHUA.

Construction of the Longyang Gorge Hydropower Station will be completed by 1989. It will have an installed capacity of 1.28 million kW and produce an annual average of 6 billion kWh. The project will cost about 2 billion yuan.

The lake forming behind the dam will irrigate 1 million hectares of farmland and supply 470 million cubic meters of water annually to local industries.

Four hydropower stations have been completed on the upper reaches of the [Huang He], at Liujia, Yanguo, and Bapan gorges in Gansu Province and Qington Gorge in Ningxia Hui Autonomous Region.

These have produced more than 120 billion kWh of electricity since 1961.

China plans to build 15 hydroelectric power stations on the upper reaches of the [river] to generate 50 billion kWh of electricity a year, according to the Ministry of Water Resources and Electric Power.

/6662

CSO: 4010/14

## HYDROPOWER

### CANADA TO UNDERTAKE FEASIBILITY STUDY FOR THREE GORGES PROJECT

OW080845 Beijing XINHUA in English 0727 GMT 8 Oct 85

[Text] Ottawa, 7 October (XINHUA)--Canada will contribute 1.6 million Canadian dollars to a consortium of Canadian firms to undertake a feasibility study of a hydroelectric project at Three Gorges on the Yangtze River in Hubei Province, China.

External Relations Minister Monique Vezina made the announcement today in Montreal at the start of an official visit by Qian Zhengying, the Chinese Minister of Water Resources and Electric Power.

The Consortium, Canadian International Project Managers (CIPM--Yangtze), composed of Lavalin, SNC, Acres, Hydro-Quebec and B.C. Hydro International, will receive 1.3 million dollars from the International Cooperation Program of the Canadian International Development Agency (CIDA) and 300,000 dollars from the Department of External Affairs through the Trade Development Fund administered by Trade Minister James Kelleher.

The feasibility study will include a review of four major aspects of the project: the second stage cofferdam, preliminary selection of construction equipment, management and organization of the project and the switching and converter stations.

The project will have a maximum capacity of 13,000 megawatts. It will not only contribute to the economic development of central and southwest China but will provide important elements for controlling the floods which for years have had disastrous effects on the region.

The Chinese minister arrived in Montreal yesterday as the guest of Trade Minister Kelleher. She will visit Hydro-Quebec's Lg-2 project at James Bay, tour both nuclear and conventional fuel power stations at Pickering and Nanticoke in Ontario and will meet Federal Minister of Energy Pat Carney before returning to China on 21 October.

CSO: 4010/6

## HYDROPOWER

### HUNAN PUSHING BOTH LARGE- AND SMALL-SCALE PROJECTS

OW160739 Beijing XINHUA in English 0655 GMT 16 Oct 85

[Text] Changsha, 16 Oct (XINHUA)--Small hydroelectric power stations have mushroomed in China's central province of Hunan where there is little oil, natural gas, or coal reserves.

In operation now are more than 9,000 such power stations, with a combined generating capacity of 2.16 million kW. Their annual electricity output is around 7.5 billion kWh, or 60 percent of the provincial total.

Most of the power stations have been linked into small power grids, which now cover 78 percent of the villages.

Each of the small power stations has a generating capacity of less than 25,000 kW.

In addition, the province has built eight large- and medium-sized power stations, each having a generating capacity of more than 25,000 kW.

More funds have been planned for the construction of hydroelectric power stations during the period of the Seventh 5-Year Plan (1986-1990), local officials said.

Power projects under construction or planned to be built will have an additional generating capacity of 2 million kW, almost double the figure for the last 35 years.

The Dongjiang Hydroelectric Power Station, on the lower reaches of the Zijiang River is one of China's key projects of the Sixth 5-Year Plan. With an [installed capacity] of 500,000 kW, the power station is scheduled for completion before the end of 1987. The first generating unit will go into operation next year. The completion of the project will greatly ease power shortages during the dry season.

The station's reservoir is the largest in the province, with a water storage capacity of 8.1 billion cubic meters.

Local authorities said that only 20 percent of the water power resources in the province has been utilized.

There are more than 800 rivers in the province. The power resources exploitable are estimated at 11 million kW, which may generated 50 billion kWh of electricity annually.

/9871

CSO: 4010/7

## HYDROPOWER

### FUJIAN SMALL HYDROPOWER STATION IS MODEL OF EFFICIENCY

Fuzhou FUJIAN RIBAO in Chinese 26 Aug 85 p 1

[Article by Xu Shicheng [1776 6108 2052] of the Taining County CPC Committee Report Group: "Successful Example of Small Hydropower Construction in Fujian--Bei Xi Two-Level Power Station Goes Into Operation and Joins the Grid"]

[Excerpt] Editor's note: Acceleration of small hydropower construction to solve energy problems is a focus of rural construction in China at the present time. Many of Fujian's small hydropower construction projects have had problems with long construction schedules, high construction costs, and slow results. There have been continual work delays and construction costs continue to soar at many projects, and some have become "bearded" projects [long overdue for completion]. We cannot adopt this method with its greater burdens on the state and the peasants. Time is money. The Bei Xi two-level power station in Taining County has taken a new route in small hydropower construction of short construction schedules, good quality, low construction costs, and fast results. Their experience is invaluable.

The government of Taixian County recently awarded a bonus of 10,000 yuan to the Bei Xi two-level power station project in acknowledgement of the construction successes of this power station, with its short construction schedules, good quality, low construction costs, and fast results, and it has extended their experiences throughout the country.

The original construction plan for this power station would have taken 2 years. It actually took only 1 and one-half years, a construction period that was one-fourth shorter. Inspection of the entire project showed that quality met design requirements and it was successfully linked with the grid for generator testing on the first try. After prices for primary and auxiliary materials were raised, total project investments were 3.57 million yuan and average construction costs were 1,426 yuan per kW, which was about 4 percent lower than the original estimate. The power station has a total installed generator capacity of 2,500 kW and produces 13 million kWh of electricity

yearly. The value of output was 845,000 yuan and it has been predicted that the total investment can be recovered within 4 or 5 years. Moreover, it laid the foundation for rebuilding and constructing the two-level Tiaoyang power station and for the Bei Xi three-level power station. Responsible persons in related provincial and municipal departments have praised the project for "outstanding compared to similar construction projects elsewhere."

12539

CSO: 4013/4

## HYDROPOWER

### BRIEFS

BAISHAN UPDATE--Changchun, 4 Nov (XINHUA)--Power shortages in northeast China will be eased when the second phase of construction on a large hydroelectric power station is completed in 1990, officials here said today. Two generating units, each with a capacity of 300,000 kilowatts, will have been installed then at the Baishan power station on the upper reaches of the Songhua Jiang, in Jilin Province. Encompassing Heilongjiang, Jilin, and Liaoning provinces, northeast China is a major heavy industrial center. One of the country's top-priority construction projects, the station will eventually have a total generating capacity of 1.5 million kilowatts. Its first phase of construction is nearing completion, following installation of three units with a combined capacity of 900,000 kilowatts, able to generate 2.03 billion kilowatt-hours of electricity a year.  
[Text] [Beijing XINHUA in English 1305 GMT 4 Nov 85] /9604

CSO: 4010/11

## THERMAL POWER

### PLANT TO BE BUILT IN LIAONING WILL BE NATION'S LARGEST

SK190305 Shenyang LIAONING RIBAO in Chinese 28 Oct 85 p 1

[Text] During the period of the Seventh Five-Plan, the state will build an especially large power plant with a design installed capacity of 2.4 million to 2.8 million kW, in Suizhong County. From 23 to 26 October, the Ministry of Water Resources and Electric Power convened a meeting in Xingcheng. At the meeting leaders of 23 relevant ministries and commissions under the State Council and the CPC Central Committee, and of people's governments at all levels of the province, as well as more than 100 specialists, examined and adopted the report on the feasibility study for this power plant.

Located 5 to 7 kilometers northwest of Dazhao village in Suizhong County's Qiansuo Township, this power plant will be accessible from the Shenyang-Shanhaiguan railway and the Shenyang-Shanhaiguan Highway. About 20 kilometers southwest to the power plant lies Shanhaiguan Station. The coal from northern Shanxi Province, which will be consumed by this power plant, can be carried on a special line of the Datong-Qinhuangdao electric railway now under construction. Bordering on Liaodong Bay of the Bohai Sea, this power plant has good geological conditions. The major buildings of this plant can be built with foundations on natural ground. The barren coastal beaches and mountain valleys can be used as ash depot locating for a relatively long period. Sea water can be used as circulating water for the plant's generating unit and can be used to remove the ash, thus enabling economization on expenses. Water for industrial use and fresh water for daily use can be provided by the Dafengkou reservoir, which will be able to provide 12 million cubic meters of fresh water annually to meet the needs of the 2.4 million-kW generating units.

The installed capacity of the first stage of the Suizhong Power Plant is designed at 1.2 million to 1.6 million kW. Upon completion, the scale of this power plant will be twice that of the Qinghe power plant, the largest among those already put into operation in our country. The Suizhong power plant is one of the especially large power plants covered by the current state planning.

/8309

CSO: 4013/25

## THERMAL POWER

### CONSTRUCTION OF 1400 MW DALIAN PLANT BEGINS

SK300351 Shenyang LIAONING RIBAO in Chinese 11 Oct 85 p 1

[Text] Construction of a large port power plant--the New Dalian Power plant--began on 28 September in an area north of Heshang Island in Dalianwan Township, Dalian City. Being adjacent to Heshang Island coal wharf which is under construction, this power plant will have an installed capacity of 1.4 million kW, and its scope will be larger than the currently largest thermal power plant in our country.

Dalian is one of the important economic development zones in our country, and it has great production potential. However, being situated at the end of the Northeast China Power Grid, the reliability in power supply is poor and the power resources are insufficient, thus hampering the economic development of this port city. The completion of this port power plant will easily solve this serious problem. Building a power plant in a port and directly putting the coal transported from the sea into production on the spot will avoid the waste caused by transporting coal inland for power generation and then retransmitting the power to Dalian.

This power plant is being built and run by the state Huaneng International Development Company. At the first stage of construction, two imported coal-fired generating units, each with an installed capacity of 350,000 kW, will be installed. The first generating unit will go into production in 1988. Upon completion, these two generating units will be able to generate 4.2 billion kWh of electricity annually, 600 million kWh more than the electricity currently consumed by Dalian in a year.

/8918

CSO: 4013/19

## THERMAL POWER

### BIDDING BEGINS ON HEBEI PLANT EQUIPMENT

OW181052 Beijing XINHUA in English 1034 GMT 18 Nov 85

[Text] Shijiazhuang, 18 Nov (XINHUA)--Bidding is now under way for supply and installation of imported equipment for a North China thermal power plant.

The plant, with a capacity of 2.4 million kilowatts will be constructed in Shang'an Township. Jingxing County, Hebei Province will get its coal supply from Yangquan, Shanxi, China's leading coal producer.

Two 350,000-KW generators will be installed during the first phase of construction which will start in April 1986. Plans call for completion of the first phase in 33 months. Ground and infrastructure preparation have already started.

This is one of China's key projects to solve the electricity shortage in the area. Investment will come from the state as well as the Province of Hebei.

Electricity from the new plant will go into the North China Power Grid, which supplies Hebei, Beijing and Tianjin.

/6662

CSOP 4010/14

## THERMAL POWER

### BRIEFS

**HUGE ZHEJIANG PLANT APPROVED**--The State Council has recently approved the building of a large power plant at Zhejiang's Beilun Port. The total generating capacity of the Beilun Port Power Plant will be 2.4 million kilowatts. The plant will be built in two phases. Two 600,000 kilowatt steam turbine generators will be installed in the first phase. The first generator will be completed in 1990, and will have an annual power generating capacity of more than 4 billion kWh. /Excerpt/ /Hangzhou Zhejiang Provincial Service in Mandarin 1000 GMT 16 Sep 85 OW/ 12228

**HAINAN TO DOUBLE POWER CAPACITY**--Guangzhou, 18 Oct (XINHUA)--Work has started on a 170-million-yuan thermal power plant on Hainan, Guangdong Province to combat the island's energy shortage. Upon completion it will double the island's generating capacity to 400,000 kilowatts. Hainan has developed rapidly since 1983, when it was empowered to adopt flexible policies to attract foreign investment. The central government is providing 105 million yuan for the new power plant, being built in two stages in a northwest suburb of Haikou City. The first stage, involving the installation of 100,000-kilowatt generating units, is scheduled for completion in 1988. This will be followed by the second stage which will add another 100,000 kilowatts of capacity. /Text/ /Beijing XINHUA in English 0851 GMT 18 Oct 85 OW/ 12228

**BIG SHIJIAZHUANG PLANT PLANNED**--A large-scale thermal power plant with an installed capacity of 2,400 megawatts will be built in Shijiazhuang City, Hebei Province. The plant will be located in the village of Shang'an, Jingxing Xian, in Shijiazhuang, and is a major state construction project. The technical equipment for the power plant will be imported and the manufacturer will be responsible for its installation. The first phase of the project is expected to begin in April 1986. [Text] [Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 14 Nov 85 p 1] /9274

**BIDS INVITED FOR COAL-FIRED PLANTS**--China has invited bids from foreign contractors to finance and build four coal-fired power plants worth US\$800 million, according to a U.S. banker. Mr Robert Schenck, a China division executive of Chase Manhattan Bank NA, said the bids were called by the Huaneng International Power Development Corp. The state-owned company was set up in June to speed up the construction of power plants by luring foreign funds and technology. Mr Schenck told BUSINESS NEWS Chase is assisting a U.S. bidder in

putting together a financing and technology package for the projects. The four power plants, with two units each, represent only the initial purchase of Huaneng, he said. Asked how the investment on the projects will be paid back, he said he expects China to make special arrangements for the conversion of foreign exchange. China will continue to rely heavily on coal-fired power plants to generate electricity in the next 5 years, according to the newly-released Seventh Five-Year Plan (1986-90) proposal. [Text] [Hong Kong SOUTH CHINA MORNING POST (BUSINESS NEWS supplement) in English 7 Oct 85 pp 1, 5 HK]

CSO: 4010/6

COAL

# OUTPUT INCREASES DURING SIXTH FIVE-YEAR PLAN

HK151451 Beijing ZHONGGUO XINWEN SHE in Chinese 0450 GMT 11 Oct 85

[Report: "Net Increase of China's Coal Output During Sixth Five-Year Plan Totals 200 Million Tons"]

[Text] Beijing, 11 Oct (ZHONGGUO XINWEN SHE)--The Sixth Five-Year Plan has added a production capacity of around 80 million tons of coal. The net increase of coal output at the end of the Sixth Five-Year Plan is estimated to reach 200 million tons, the highest rate in the history of China's coal industry.

During the first 4 years of the Sixth Five-Year Plan, the output of coal increased at an average of 42.28 million tons a year, up 33 percent over the Fifth Five-Year Plan period and fulfilling the quotas of the Sixth Five-Year Plan 2 years ahead of schedule. The output during this period was over 700 million tons. In the first 9 months of this year, the output of coal increased by 65 million tons over the corresponding period of 1984. It is estimated that the total coal output will reach 820 million tons by the end of the year. Compared with the 620 million tons at the end of 1980, the output over 5 years shows a net increase of 200 million tons.

Two hundred mines have been newly built or expanded during the Sixth 5-Year Plan period, adding a production capacity of 79.81 million tons of coal. By the end of 1985, a total of 21 billion yuan will have been invested in the coal industry, an increase of 55 percent over the Fifth Five-Year Plan. The new mines put into operation during the Sixth Five-Year Plan include 271 opencut mines with the capacity of 118.54 million tons.

In order to relieve the strain on coal supply in northeast China, east China, Beijing, Tianjin, Hunan, Gubei, Guangdong, and Guangxi, the building of 14 major mines has been strengthened during the Sixth 5-Year Plan. They include the mines in Kailuan, Datong, Yangquan, Gujiao, Pingshuo, Huolinhe, Tiefu, Shuangyashan, Datun, Southern Huaihe, Northern Huaihe, Yanzhou, Zaozeng, and Pingdingshan. During this period, new coal mines that can produce 3 million tons of coal annually have been built and put into operation. They include the Shanxi Gujiao Xiqu mine, the Southern Huolinhe opencut mine, and the Henan Pingdingshan No 8 mine. In addition, foreign investment has been used to build the Shanxi Pingshuo Antaibao opencut mine, the Shanxi Luan Changchun mine, and other large, modern mines.

/8918

CSO: 4013/19

## COAL

### DECLINE IN CONSUMPTION ALLOWS GREATER STOCKPILING

Beijing JINGJI RIBAO in Chinese 18 Nov 85 p 3

[Article by the Industrial and Transportation Department, State Bureau of Materials: "China's Coal Supplies Abundant; Production Has Increased, Consumption Has Decreased and There Are Greater Reserves"]

[Text] Through the first 9 months of this year, China's output of raw coal increased 11.5 percent and consumption increased 8.8 percent compared to the same period last year, and by the end of September, coal reserves had grown 38.3 percent compared to the beginning of this year and 28.2 percent compared to the same period last year. The number of days the supply of coal can be used increased by 10 compared to the same period last year. One of the reasons for this heartening situation which we have seldom seen in recent years is that there has been a fairly small decline in the consumption of coal. In the first 9 months of this year, the average amount of coal consumed for 100 million yuan of industrial output in China decreased 8.5 percent compared to the same period last year, which resulted in savings of 38 million tons of coal.

There has been a general increase in the reserves of key industrial and communications departments, and there have been improvements in supplying coal to those regions that need it. By the end of September, the coal reserves of the country's industrial and commercial departments increased 28.7 percent compared with the beginning of the year and increased 27.1 percent compared to the same period last year, and the number of days that these reserves can be used increased 6 percent compared to the same period last year. The reserves of key coal-using units generally increased; for example, the number of days that the reserves of coal can be used by hydropower departments increased by 4.7 compared to the same period last year, and the number of days that the coal reserves from the four large grids of northeast, east and central China and Tianjin can be used increased by 5.1 compared to the same period last year. Because the centralized procurement coal assigned by the state to Guangdong, Guangxi, Hubei, Fujian and other provinces and regions is plentiful and the quality of locally-produced coal is substandard, the amount of unmarketable coal increased.

Coal reserves of commercial departments are plentiful, and the market price of coal has dropped. By the end of September, the coal reserves of the nation's

commercial departments increased 62.4 percent compared to the beginning of the year and 31.1 percent compared to the same period last year, and current coal reserves are sufficient for more than three months of sales. Each region also has a fairly abundant supply of coal for heating: at the end of September, the amount of coal organized within the plan in Xian increased 22.4 percent compared to the same period last year. In Changsha, Zhengzhou and other places in which the coal used by the residents is in tight supply, coal can now be purchased at will. Because of the favorable situation in the supply of coal, the market price has dropped. Since February of this year, the price of market adjusted coal in Shanghai has already dropped four times. At the beginning of the year, the market adjusted price in Hefei, Anhui Province was 123 yuan per ton, and by the end of August the price had dropped to 102.8 yuan per ton.

The main problems which currently exist in the production and supply of coal are: The stockpiles of coal in mines continue to increase. At the end of September, the amount of coal stored in the nation's mines increased 37.6 percent compared to the beginning of the year and 27.7 percent compared to the same period last year. The main reason for the stockpiles is that the rate of increase in production has exceeded transportation capabilities. The severe stockpiling is currently affecting regular production, and we must urgently adopt measures to solve this problem.

/9274

CSO: 4013/31

COAL

NOW MINISCULE, COAL EXPORTS COULD TAKE A QUANTUM LEAP

Hong Kong JINGJI DAobao [ECONOMIC REPORTER] in Chinese No 33, 19 Aug 85 pp 19-20

[Article by Zhao Wei [6392 0251]: "China Has Tremendous Potential as a Coal Exporter"]

[Text] In the wake of coal production developments and the open door policy, Chinese coal exports have been increasing year after year, from 3.12 million tons in 1978 to 6.97 billion tons in 1984, a 100 percent jump in 6 years. Our planned export this year represents a 5 percent increase over 1984. It is estimated that Chinese coal exports will continue to expand in the next 5 years and will probably exceed the present total several times by 1990.

#### Conditions Favorable to Coal Export

Many circumstances favor China as a coal exporter. The country is well endowed with coal deposits. Its proven coal reserves of more than 770 billion tons are the third largest in the world and it is the world's second largest coal producer. Moreover, Chinese coal comes in a multitude of types and grades, including Datong's [motive power] coal, Kailuan's coking coal, and Ningxia's "Taixi coal," (a high-grade anthracite,) all of them traditional exports which are popular among overseas customers. Second, China's competitiveness is enhanced by its proximity to countries in Asia and the Pacific region. Last year, about 55 percent of Chinese coal exports were shipped to Japan, 14 percent went to Hong Kong, Singapore, Malaysia and the Philippines and 28 percent were bought by Korea. Some was also exported to Europe. When Hong Kong or Japan buys coal from China instead of from Australia, the United States, Canada or South Africa, it can make considerable savings in freight as the distance over which the coal has to be shipped is reduced by anything from 2,600 to 5,700 nautical miles. Also, China is free from strikes and production stoppages and can therefore guarantee stable supplies. In recent years China has been able to honor 80 to 90 percent of its coal sale contracts, a very high rate.

Although the volume of China's coal exports has been rising each year, it remains quite small in absolute terms and pales in comparison with the exports of such major coal exporting nations as the United States, South Africa, Poland and Canada. At present, our coal export amounts to less than 1 percent

of domestic output and makes up just 2.3 percent of total world trade in coal. In fact, mainland coal accounted for only 15.6 percent of the coal imported by Hong Kong last year. This shows that China has immense potential as a coal exporter. Last year China earned \$290 million in foreign exchange by exporting coal, so the expansion of coal exports is a major way to earn more foreign exchange.

A primary factor affecting coal export expansion in the past was the failure of coal production to keep up with domestic economic demand. Widespread coal shortages at home effectively put a lid on any substantial increase in coal exports. As a result of increased state investments in the coal industry over the past few years and the adoption of the principle of "the state, the collective and the individual doing well together," the coal industry has made greater progress, fulfilling the planned annual target of 700 million tons under the "Sixth 5-Year Plan" in 1983, 2 years ahead of schedule. According to the latest statistics, coal output in 1984 exceeded 789 million tons, up 10.5 percent over 1983. During the first half of 1985, coal output reached 414 million tons, an increase of 11.8 percent over the same period in 1984. Domestic coal shortages have also eased. The "Seventh 5-Year Plan" tentatively calls for an average annual increase of 30 million to 40 million tons for the next 5 years, an increase more than double that under the "Sixth 5-Year Plan." This way we can both ensure domestic energy supplies and provide a resource for export expansion.

#### Transportation Must Be Improved

Transportation was another factor which has held down coal exports in the past. Previously, coal haulage relied mainly on railroads. In fact, coal makes up about 40 percent of the volume of rail freight nationwide and more than 60 percent in coal-rich Shanxi. Because of limited rail carrying capacity, coal piles up in places like Shanxi where tens of millions of tons of coal are stranded each year. In addition, ports which handle coal exports also suffer from a lack of loading capacity.

The Chinese government has identified energy and transportation as the major focuses of national economic development in the next 5 years. Railroad development will emphasize increasing Shanxi's capacity to move coal out of the province because Shanxi produces and exports the largest amount of coal in the nation. Its output last year was 187 million tons, or 23.7 of the national total; with approximately 110 million tons shipped out of the province, it contributed 44 percent of all Chinese coal exports. The present coal-carrying capacity of our railroads and highways is only 108 million tons, even when they are working at full capacity. To increase our coal-carrying capacity, six railroads in Shanxi are being modernized. Railroads linking Datong and Beijing, Shijiazhuang and Yangquan, and Chengzhi and Jincheng either have been electrified or are in the process of being so modified. Also under construction at the moment is a new, double-track and electrified railroad to run between Datong and Qinhuangdao with a coal carrying capacity of 55 million tons upon the completion of the first phase. The modernization of existing railroads and highways and the construction of two new railroads should increase the capacity to transport coal out of Shanxi by 150 percent by 1990, thereby meeting the basic needs of coal exports.

Major ports handling coal exports, namely those at Qinhuangdao, Lianyungang, and Qingdao, are all expanding their coal piers or building new ones. The coal pier at Qinhuangdao is currently one of the nation's key construction projects. Stage 1 of the project was completed and put into service in 1983 and stage 2 became operational last July. The pier can now handle 50 million tons of coal annually. Upon the completion in 1988 of stage 3, which began this year, its annual capacity will increase by 30 million tons.

Another large coal pier scheduled for completion this year can be found at the port of Shijiusuo in southeastern Shandong. The Shijiusuo port will be responsible for the outbound shipment of coal produced in such provinces as Shandong, Shanxi, and Anhui. It has an annual coal loading capacity of 15 million tons and can accommodate 100,000-ton ships.

Concurrently, China is going all out to develop inland coal transportation and is now building coal piers at Zhicheng and Wuhan along the Chang Jiang and two deep-water berths in Nantong, Jiangsu which can accommodate 100,000-ton ships. Coal shipped from the upper and middle reaches of the Chang Jiang will be loaded onto outbound vessels at these facilities. Coal piers will also be built at Gui Xian, Guangxi in southern China to handle the loading and shipment of Guizhou-produced coal to Hong Kong and Guangdong via the Xi Jiang. In addition, China is buying heavy-duty trucks to develop coal transportation by land and plans are afoot to build coal slurry pipelines. China is resorting to a variety of transportation methods to improve coal haulage.

#### The Construction of Coal Export Bases

The Datong coal mine in northern Shanxi and other local mines in Yanbei Prefecture (including mines operated by the province, municipalities, counties, rural and small town collectives, as well as small mines run by individuals) are currently the main source of motive power coal exports. Coal produced in this part of the nation is collectively known as "Datong coal." With an average ash content of about 10 percent, sulfur content of below 1 percent and a calorific capacity of at least 7,500 Kcal per kg, "Datong coal" is a high-grade dynamic coal and also ideal for gasification. This region exported 2.98 million tons of coal last year, 42.8 percent of total national coal exports. Of all Chinese coal exports to Hong Kong, 97 percent is "Datong coal." This mining region is expected to develop fairly rapidly in the next 5 years when the Datong coal mine's annual output will exceed 35 million tons, up from 29 million tons last year, and the output of local mines will also increase from the present level of 18 millions to 40 million tons. As output increases, so will exports.

Coking coal mainly comes from such mines as Kailuan, Zaozhuang, Huaibei, Fushun, Hegang, and Shuangyashan. With annual exports of 1.5 million tons, the Kailuan mines constitute China's largest coking coal producing center at the moment. As existing pits are modernized and expanded and two new pits put into service, annual output at Kailuan will increase from last year's 16 million tons to 26 million tons over the next 5 years.

Anthracite is primarily produced in such mines as Yangquan, Jincheng, Jingxi, Rujigou, and Gulaben. A high-grade anthracite, "Taixi coal," mined at Rujigou

in Ningxia, has established itself in the Western European market. With modernization, this mine has increased its annual production capacity from 600,000 tons to 900,000 tons, with possible increases in both output and exports. The Yangquan coal mine in Shanxi currently accounts for the largest share of China's anthracite exports and is expected to produce 15 million tons in 1990, up from the present level of 13 million tons.

Apart from the above existing coal mines, two large coal centers will be built in the coming 5 years to produce coal for the foreign market. One of them will be the Yanzhou coal mine in Shandong, where four pits have been completed and three more are under construction. As these pits become successively operational in the years before 1990, the Yanzhou mine will develop into a key mining center capable of producing 12.85 million tons of coal annually. It is situated near and is linked by rail to Shijiusuo (about 300 km away,) so coal transportation is fairly convenient. The other is the Pingshuo coal mine in Shanxi. The Antaibao No 1 open pit here is currently the largest Chinese-United States joint venture. Construction formally began last July and production is scheduled for 1987. Projections call for an output of 15 million tons as early as 1988. Over half of the high-grade motive power coal produced here will be exported.

Looking ahead, it appears that both the Jungar mining area in the Nei Mongol Autonomous Region and the Shenmu mining area in Shanxi will become vital coal export centers. The planned annual production capacity of the Heidaigou open pit in the Jungar mining area is 25 million tons, and the government has decided to finance its construction with energy loans from the Japanese government. A new mining area which has yet to be developed, the Shenmu area is richly endowed with high-grade coal deposits (87.7 billion tons of proven reserves). (Their average ash content is only 6 to 9 percent, sulfur content 0.2 to 0.8 percent, and calorific capacity 7000 Kcal per kg. Moreover, a substantial part of the ash content is calcium oxide which helps to further reduce the amount of sulfur released into the atmosphere when the coal is burned and prevent pollution.) According to the "conceptual comprehensive plan" jointly commissioned by the China Coal Development Co and the Universal Tanker Co and developed by Bechtel Civil Engineering and Minerals Inc of the United States, there are 12.4 billion tons in proven reserves within an area of 1,200 sq km. The plan envisages a mining area with three open pits and two mines capable of producing 50 million tons annually. The plan report suggests that this mining area should be highly competitive in the international market as it is blessed with the world's finest dynamic coal and has low production costs. China plans to build a new railway here to speed up its development.

Guizhou Province will also speed up its coal exports in the future as the existing Liupenshui mine is modernized and expanded and local mines become operational.

12581

CSO: 4006/974

## COAL

### COAL EXPORTS TO GROW DURING SEVENTH FIVE-YEAR PLAN

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 14 Nov 85 p 1

[Text] This reporter has learned from the China Coal Export-Import Company that to date this year China has already exported 5.83 million tons of coal, fulfilling 87 percent of the year's plan.

China plans to export 6.7 million tons of coal this year and actual exports by the end of the year may reach 7 million tons. Last year, China exported 6.97 million tons of coal.

Today, most of the coal exported by China is high-grade motive power coal, coking coal, and smokeless coal with low ash and sulphur content sold to Japan, Korea, the Philippines, France, and Hong Kong.

In the last 10 months, Shanxi Province, the nation's top exporter, has exported 2.6 million tons of coal. Next is Hebei Province, with exports of 860,000 tons. One-half of the coal exported so far this year came from local mines.

China is now in the process of constructing six big coal production bases and will rebuild and expand several bases geared primarily to coal exports. It is expected that coal exports will continue to grow yearly during the Seventh 5-Year Plan.

/9274

CSO: 4013/31

COAL

## RAPID DEVELOPMENT OF NORTHEAST COAL INDUSTRY

Changchun JILIN RIBAO in Chinese 7 Aug 85 p 4

[Article: "The Coal Industry in the Northeast and Nei Monggol Regions Is Developing More Quickly; Major Reforms of Centralized Leadership and Unified Management Have Been Implemented in Managerial Systems"]

[Summary] China's Northeast and eastern Nei Monggol regions have accelerated the pace of development of the coal industry by implementing the major reform of centralized leadership and unified management in managerial systems. The Joint Northeast--Nei Monggol Coal Company is an economic organization with independent administration and accounting that functions as a representative of the Ministry of Coal Industry in managing the region's coal industry.

The company has transferred authority downward in such areas as cadre management, labor management, plan management and so on. It also has raised capital and key equipment from many sources to assist a number of mining service bureaus in Liaoning and Jilin with shrinking resources and difficult conditions, which has reversed a tendency toward a decline in production and made it possible for some newly-constructed mines to go into operation on schedule.

Over the past 2 years, raw coal output in all of the mine service bureaus under the company's jurisdiction grew at an average rate of 6.6 percent per year, which was higher than the growth rate in China's unified distribution coal mines. Coal output increased by more than 14 million tons, which is equivalent to the output from an additional large-scale mine service bureau. Raw coal output during the first half of 1985 also was up by 8.73 percent over the same period in 1984. This was the best period for the Northeast and eastern Nei Monggol in terms of the amount of investments in capital construction of coal mines and number of projects completed, the large number of new mines handed over and the largest scale of construction startup. Some 18 of the 24 new mines and mine transformation and expansion projects have been completed and put into operation.

12539

CSO: 4013/181

## COAL

### BRIGHT PROSPECTS FOR NORTHEAST COAL FIELDS

Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 16 Oct 85 p 3

[Article by reporter Liu Xieyang [0491 3610 7122]: "Bright Prospects for Northeast Coal Fields--A Full Complement of Coal Varieties with Total Reserves of 60 Billion Tons Equal to One-Sixth of the National Total--People from Abroad Are Welcomed for Broadly Undertaking Joint Development"]

[Text] Everyone says that China's Shanxi Province is rich in coal resources. This reporter went on a long-range visit to the northeast recently to see the large amounts of coal in this region, the abundance of resources and the good conditions.

The northeast is China's second energy resource base area. It includes Liaoning, Jilin, Heilongjiang and three leagues and one city in Nei Monggol. It covers an area of 1.25 million square kilometers extending east to Jixi and Hegang, west to Jinzhou and Nanpiao, south to Dalian and north to Jalainor in Manchuria. It has proven coal reserves of more than 60 billion tons. Yearly output at present is more than 130 million tons, second only to China's "coal town," Shanxi, and it accounts for about one-sixth of the national total. There is a full complement of coal varieties here. There is coking coal for smelting steel, lignite for use in the chemical industry, power coal that can be used to provide electricity....

The reporter arrived at the largest mine in the northeast, the Hegang coal mine. This mine now has a developmental history covering 68 years. During the Republican and puppet Manchukuo periods, the mine shafts were broken and destroyed and yearly output was only a few 100,000 tons. After Liberation, various factors caused annual output to fluctuate around 7 million tons. This was especially true of the period of the Great Cultural Revolution, when the lowest output was only 3 million-plus tons. Output increased many-fold after the "gang of four" was smashed. Now, yearly output exceeds 14 million tons and it has jumped to fifth place nationwide.

Recently, new coal fields with reserves of nearly 500 million tons have been found around Hegang. The mine now is preparing for active importation of advanced foreign technologies, and yearly output may reach 20 million tons by the end of this century.

Hegang's the Jixi coal mine is an old mine with a history covering more than 70 years. Total predicted reserves in this

mining region are 4.8 billion tons and can be extracted for more than a century. The most obvious characteristic of this mine is that mechanized coal extraction now exceeds 88 percent, making it the mine with the most mechanized coal extraction in China. Output reached 13.48 million tons in 1984, about the same as the Hegang coal mine.

The Qitaihe coal mine is located between Shuangyashan and the Jixi coal field. It has been developing gradually since 1958. This area produces large amounts of low sulfur and low phosphorous coking coal that is an important fuel in steel smelting. The technology was rather backward when construction of the mine first began and coal extraction equipment was very simple. Now, however, it has modern coal extraction equipment and high efficiency conveyor belt equipment and automatically controlled power plants have replaced the backward production of the past. Last year, this mine strengthened coal management and expanded its washing and shipping capacity. Sales markets have been opened up substantially and improvement of product types alone during the first half of 1985 increased income by more than 1.3 million yuan. This mine has reserves in excess of 1.3 billion tons and yearly output in the mine now exceeds 5 million tons. It currently is in the process of moving toward a 10 million ton mine.

The Huolin He coal mine located on the Horqin grasslands of Nei Monggol is the first large open-pit coal mine to be built in China. It covers an area of 540 square kilometers and has geological reserves of 12.9 billion tons, which includes the 2.5 billion tons precisely surveyed in the Sarhure open-pit mine in a total of 24 coalified strata. The coal is lignite and is suitable as a raw material for the chemical industry. The maximum thickness of the coal seam is 81 meters, which is as tall as a 27 storey building.

The southern coal mine at Huolin He now basically has been completed and it went into formal operation in September 1984. Other earthwork projects covering a construction area of more than 530,000 square meters now are developing on a large scale. The 400-plus kilometer long Caoyuan [grasslands] railway that connects with the mining region now is open to traffic, and construction of high voltage power transmission lines is proceeding with urgency.

There are two other open-pit mines in Nei Monggol, the Yimin He coal mine and the Yuanbaoshan coal mine. The conditions at these two mines are even more favorable than at the Huolin mine and construction now is proceeding urgently.

Responsible persons at the Northeast China Nei Monggol Joint Coal Industry Company told this reporter that the northeast is one of China's key economic regions. It has developed industry and convenient communications, and it contains one-fourth of China's iron and steel industry, one-sixth of the machinery industry, and one-fifth of non-ferrous metals. It must bring in more than 27 million tons of coal from other areas each year, however. The tasks involved in accelerating construction of the coal mining industry in the northeast are arduous ones. The main problems at present are inadequate supplies of capital and a lack of technical forces. For this reason, those abroad are extremely welcome to engage in economic and technical cooperation.

12539/12899  
CSO: 4013/22

COAL

OUTSTANDING RESULTS OF HUAINAN XIE NO 1 COAL MINE DESCRIBED

Beijing RENMIN RIBAO in Chinese 26 Aug 85 p 2

[Article: "Good Results Created in Coal Production at Xie No 1 Mine; Large Mines Lead Small Mines in Extracting Residual Coal"]

[Text] ANHUI RIBAO has reported that an advanced enterprise, the Huainan Xie No 1 line, has practiced "large mines leading small mines" during the reforms and has dealt correctly with the relationship between the state and enterprises. Since 1980, there has been a substantial increase in raw coal output and economic results have improved continually. Actual output at this mine in 1984 reached more than 2.09 million tons, more than double the mine's design capacity. The Xie No 1 mine is a large mine with a design yearly output of 900,000 tons. After 1980, the leadership began an earnest search for new routes to invigorate large enterprises. After survey research, the mine leadership realized that the use of residual coal resources in large mines to develop small mine production is an effective route for implementation of the CPC Central Committee's [decision] concerning "joint advances by the state, collectives and individuals" in coal development, and that it was the correct route for invigorating large enterprises and servicing to local economic construction. They used not a cent in state investments during the process of building small mines to recover residual coal. By July 1985, small mines had produced 720,000 tons of coal, which included 419,000 tons supplied to Huainan City, making up for the shortage in energy resource supplies in the area.

"Large mines leading small mines" is a good method for developing production and invigorating enterprises that was explored by the Xie No 1 mine during the reforms. The fact that the large mines and small mines both produced coal from the same shaft during the period immediately following their creation caused some people to make comments. They were afraid that the different systems of ownership and the different jurisdictional relationships would lead to small mines encroaching upon the interests of the state. In regard to this question, the mine leadership pointed out clearly from the beginning that the development of small mine production also was for the purpose of providing more energy resources need greater accumulation for the state and definitely was not merely due to the local and present interests of the enterprises. To guarantee that there was no encroachment upon the interests of the large mines,

they formulated a set of management systems for development of small mines. In the area of output calculations, the mines gave attention to fostering the supervisory role of output and marketing departments in large mines, and they calculated the amount of residual coal for extraction in the small mines in strict accordance with data on geological reserves to guarantee that the "small mines would not harm the large mines." Because this mine dealt rather well with the relationship between large mines and small mines, stable development of small mine production last year was achieved in conjunction with large mines producing more than 220,000 tons over quota and creating the best record in recent history. This has led to the appearance of a pleasing situation of concurrent growth of large mines and small mines.

When the small mines become rich, they do not forget the large mines, and when the large mines become rich, they do not forget the state. This is an important experience of the Xie No 1 mine in dealing well with the relationship between the state and enterprises. The negotiated price of coal has risen continually in recent years, and coal from small mines can be sold at high prices on the market. This mine's leaders have taken a comprehensive view, however, and have used coal from the small mines in the last 2 years to supplement more than 75,000 tons of shortages in unified coal output in the mine service bureau. During the shortage of labor power in the large mines in 1984, the small mines negotiated to provide more than 2,800 people to assist the large mines, and the small mines provided wage assistance of 2.2 million yuan to the large mines. As small mine production has developed, they also have undertaken the heavy task of providing capital for technical transformation and improvement of living facilities in the large mines. Since 1981, the small mines alone have provided the large mines with 156 pieces of equipment worth more than 2.7 million yuan.

12539

CSO: 4013/181

## COAL

### GREAT INCREASE IN OUTPUT OF COKING COAL AT QITAIHE REPORTED

Harbin HEILONGJIANG RIBAO in Chinese 1 Oct 85 p 2

[Article: "The Qitaihe Mining Bureau Raises Output of Coking Coal by One and One-half Times Over 10 Years"]

[Text] The Qitaihe Mining Bureau, one of China's primary coking coal base areas, has been steadfast in the transformation of mining techniques, and has raised the level of mechanization in coal extraction from 25 to 77.2 percent. Coking coal output has risen from 2 million tons in 1976 to 5.50 million tons, an increase of 1 and one-half times over a decade. They are helping to provide China's iron and steel industry with ever-increasing amounts of high quality coal.

This mining bureau has five coal mines and 19 small terraced ["bobbin"] slope mines. Production is decentralized, which has obstructed the large-scale development of mechanized production, and state plans were not completed for 8 years in a row. This bureau carried out technical transformations in 16 of the small slope mines in the four Xinjian, Xinxing, Taoshan, and Xinli mines in 1976. After 8 years of efforts, they completed the first stage of the transformation project, which has turned all of the mines into concentrated large belted slope mines. Coal extraction, excavation, lifting, transport, and ventilation systems have been centralized in a rational manner. Lifting capacity in each of the mines has reached 1.68 million tons [per year] and production capacity has more than doubled. Only 75 yuan in investments were required for each ton of increased production capacity. The investments required to increase the production capacity were 150 million yuan less than the amount required to build a new mine of similar size.

Mine transformation in this bureau has facilitated development of mechanized production. Besides state investments, they also collected their own capital from all possible sources to purchase extraction machinery. In the past few years, they only had a single importing project for hydraulic unibody coal extraction work face supports, for which they invested 9 million yuan in capital. Mechanized extraction was achieved on 21 of the bureau's 35 coal extraction work faces in 1984, and the level of mechanization has increased from 25 percent before the retransformation to 77.2 percent at the present time.

Technical changes in mines have brought about enormous changes in this coking coal mining region. Each coal extraction work face produced only 4,000 tons per month in 1976, but the figure already exceeds 7,500 tons at the present time. Overall labor productivity has increased by 24 percent.

12539/12955

CSO: 4013/15

COAL

AERIAL REMOTE SENSING UNCOVERS NEW RESERVES

OW041122 Beijing XINHUA in English 0847 GMT 4 Nov 85

[Text] Beijing, 4 Nov (XINHUA)--Remote aerial sensing technology has been used in China for coal prospecting since last year, and has already shown positive economic benefits.

According to the remote aerial sensing company attached to the coal industry ministry, the new technology can double the speed of coal prospecting and save as much as half the cost.

One of the major scientific projects in China's Sixth 5-Year Plan (1981-85), the new technology was used for the first time in the Inner Mongolia Autonomous Region and helped discover new coal reserves of 3.4 billion tons. It also saved the geological department of the Ministry of Coal Industry 300,000 yuan by ruling out the possibility of coal deposits in another area of Inner Mongolia.

Remote sensing was used last year by the same company to draw up the country's first complete set of spectrum test data of the Paleozoic coal series in northern China. This has made China one of the most advanced countries in the study of thermal radiation of coal beds.

The remote aerial sensing company is producing geological maps of various scales.

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CSO: 4010/8

## COAL

### ANHUI OVERFULFILLS ENERGY PLAN

OW040647 Hefei Anhui Provincial Service in Mandarin 1100 GMT 31 Oct 85

[Excerpt] During the Sixth Five-Year Plan period, Anhui has achieved marked results in developing and economizing energy resources. In 1984, the province's primary energy output was equivalent to 20.09 million metric tons of standard coal, an increase of 14.2 percent over 1980 and an average annual increase of 3.4 percent. The province has overfulfilled the energy production task set under the Sixth Five-Year Plan by 9.8 percent 1 year ahead of schedule.

Coal is Anhui's principal energy resource. In 1984, the province produced 27.56 million metric tons of raw coal, which constituted 98 percent of the total primary energy output and showed an increase of 14.3 percent over 1980, and overfulfilled the 25.25 million-metric ton raw coal task set under the Sixth Five-Year Plan 1 year ahead of schedule.

During the Sixth Five-Year Plan period, Anhui's local coal mines have rapidly developed, and their output has increased by big margins. As a result, they have strongly supported the province's economic construction and played an active role in easing the shortage of energy resources in the province.

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CSO: 4013/20

## COAL

### OPINIONS OFFERED ON COAL FIELD GEOLOGICAL EXPLORATION

Beijing ZHONGGUO DIZHI [CHINA GEOLOGY] in Chinese No 6, 13 Jul 85 pp 15-17

[Article by Wang Wenlong [3769 2429 7127] of the Xi'an Mining College Geology Department: "Some Proposals Concerning Geological Exploration Work in Coal Fields"]

[Text] Coal field survey and exploration work during the 1950's and early 1960's was carried out through the joint efforts of the Ministry of Coal and the Ministry of Geology. They located quite a few large coal fields for construction in the First and Second Five-Year Plans and proved substantial geological and industrial reserves. The Ministry of Geology began assuming responsibility for fewer tasks in the mid-1960's, and there was a relative increase in the amount of geological and industrial reserves proven by the Ministry of Coal.

The Ministry of Coal made a national forecast of coal fields in the 1970's that provided directions for future investigations and surveys of coal field prospects. Beginning in the 1980's, the need for construction of the "four modernizations" led the Ministry of Coal Industry and the Ministry of Geology and Mineral Resources to cooperate once again on surveys, investigations, and exploration concerning coal field prospects. This unified our pace and continually improved the degree of work and research. The author will discuss some of his views based on past experience:

#### I. The Need for Unified Demarcation of Exploration Stages and Degree of Exploration

Over many years of practice in exploration and based on experiences in China and abroad, the Ministry of Coal Industry and the Ministry of Geology and Mineral Resources have delineated the stages of exploration. Although they used different terminology, they are quite close in their actual nature (as shown in the following table).

Table 1: Comparison of Stages in Coal Field Geological Exploration  
Used by the Ministry of Coal Industry and the  
Ministry of Geology and Mineral Resources

System	Stage			
	Coal field survey		Coal field exploration	
Ministry of Coal Industry	Survey coal exploration (coal exploration)	Survey exploration (survey)	Detailed exploration (Detailed surveys of mining regions or detailed surveys)	Precision exploration (Precision surveys of mines or precision surveys)
Ministry of Geology and Mineral Resources	Preliminary surveys or preliminary coal exploration	Detailed surveys or detailed coal exploration	Preliminary exploration	Detailed exploration

I always have felt it inconvenient to use the classification outlined above. There is no need for two different classification methods for a single type of mineral or within a single country. (Footnote 1) (This article uses terminology of the Ministry of Coal Industry.)

The need for unified classification of the stages of exploration and degree of exploration should, of course, be identical. The current low level of exploration and development techniques in China means that the degree of exploration generally is rather low. Improvements in the levels of exploration and extraction will bring about a need for unified stipulations concerning different stages of exploration and degrees of exploration.

## II. Assuring Good Basic Geological Work

Work and practice over many years have proven that good basic geological work is of particular importance for geological workers. Coal deposits are stratigraphic and assume a stratigraphic distribution as flammable organic sedimentary rock deposits over a wide area. The control and effects of paleoclimate, ancient vegetation, ancient geographic, ancient structures, transformation during later periods and other areas cause situations of variable thickness, branching, disappearance, destruction by fracturing and so on, which lead to substantial regional variations in coal deposits. This directly affects normal production to the extent that some mines have never attained designed output for a long time. This must attract the attention of geological exploration workers and we should focus on it through basic geological work.

1. Do good surface geology work. This is the primary link in doing all geological work well. Exploration work has reached the stage of sample surveys and even precision surveys in some areas, but still no single topographic and geological map suited to Chinese standards has been compiled. Surface geology work is still underway in some regions and many geological structures have not yet been investigated. There is only blind exploratory drilling, which has led to irrational work deployment and serious waste. None of this is permissible when geological work procedures and economic results are taken into consideration, and it should be corrected immediately.

2. Obtain comprehensive and standardized primary geological data. From beginning to end, surveys and exploration work should seek comprehensive and standardized primary geological data according to geological requirements. There are two prominent problem areas at present: One is poor quality of exploratory drilling and measurement wells, and the other is the low level of geological record-keeping, which has a direct effect on the reliability of primary data. This urgently requires higher quality exploratory drilling in coal fields and the popularization of diamond drills with wire-line coring, as well as an improvement in professional levels and a sense of responsibility of geological and measurement well personnel in their work.

3. Strengthen sampling experiment work. All types of samples should be taken in strict accordance with the requirements of sampling regulations and should be tested immediately. The items of research and testing should conform to requirements. Import advanced chemical and physical methods to measure the distributional and endowment conditions of various elements or compounds. We must establish a strategic viewpoint concerning comprehensive exploration and comprehensive evaluation of the different mineral products found in coal system strata. The phenomenon of several exploration teams running back and forth from the exploration region cannot be allowed to reappear.

### III. Improving the Degree of Exploration and Research

1. Strengthen the application of comprehensive exploration methods. Most coal field survey and exploration work now has become oriented toward deep and concealed areas. Successful experience already has been gained in comprehensive exploration methods that integrate geology, exploratory drilling and geophysical prospecting, which proves that they can be used in every stage of exploration. The search for coal stage: The use of gravitational and electrical methods can provide a preliminary understanding of coal systems distributions, depth of burial, thickness of capping strata and the shapes of primary structures to provide a reliable foundation for confirmation through exploratory drilling. The survey and exploration stage: The use of electrical methods, seismology, and exploratory drilling can permit further understanding of the distributional scope of coal systems, depth of burial, thickness of capping strata, and the primary controlling fractures and structures that can assist in completion of geological maps of the base rock, and it also can provide faster evaluation of overall plans for exploration regions. The sampling and precision survey stage: An integration of seismic methods and exploratory drilling can provide abundant and reliable

data concerning the primary geological structures of the mine region or mine shafts under investigation to meet the needs of overall planning and mine shaft design in mining regions. Geophysical measurement wells penetrate throughout all stages of exploration and play a decisive role in study and comparison of qualitative and quantitative questions, coal quality and lithology and in popularization of coreless drilling methods.

2. Closely integrate reserve categories with geological, extraction and economic factors. Classification of coal reserves in China gives insufficient consideration to the feasibility of development and economic results, to the extent that some mines have been unable to achieve recovery designs. A mine region or mine may have invested in more exploration projects and may reliably and rationally consider it a region of high-grade reserves, but extraction conditions and technologies are not certain to be favorable and it is not certain that it is suited to mechanical extraction, so it actually may not provide the condition for optimum economic results.

The specific principles used to classify reserves in foreign countries, especially in England, are: 1) To reflect the accuracy of reserves and the feasibility of development; 2) To begin from geological factors, engineering factors, and economic factors; and 3) To calculate recoverable reserves in the final geological report. In this way, the degree of reliability of reserves is closely integrated with the size of benefits from recovery. Besides considering geological factors, determination of the grade of reserves should vary in accordance with extraction and economic factors.

3. Reform exploration, strengthen key research.

1) On the basis of key research on coal system geology and coal deposits, determine the beneficial mineral products and useful elements associated with and symbiotic with coal system and non-coal system strata. Technical measures, exploration methods, exploration equipment, technical forces and other areas should adapt to this need. It is best if a single geological team can assume responsibility for a single mining region or area and that it be relatively solid, with responsibility to the end.

2) Correctly implement exploration regulations. This is especially true when determining the type of exploration to be used in new exploration regions or when deploying exploration projects. There should be serious research, comparison, and evaluation of the degree of complexity of geological structures and the degree of stability of coal beds. Otherwise, errors may occur. For many years, the degree of exploration in many exploration regions has been inadequate and the fractures have not been investigated. Exploration projects supplement themselves one after the other. The main reason for this is an inappropriate determination of the type of exploration and irrational deployment of exploration projects.

3) Import advanced exploration techniques, investigate the small [geological] faults that affect extraction. Statistical data from the Soviet Union shows that only faults with a drop of more than 10 to 15 meters can be detected using surface exploratory drilling methods. The method of geophysical

exploration between wells is an effective method for measuring coal bed structures. West Germany has been using tunnel exploration, exploratory drilling, measurement wells, slot wave seismic exploration, statistical analysis of structures and underground stereoscopic photography techniques to study and predict small structures, which has rationalized extraction and made it continuous. This deserves our study.

4) Include the geological conditions of mine extraction in key research. Practice has proven that the geological conditions of extraction are important factors affecting the ability to achieve normal extraction. Modern coal producing mines are large scale and have few working faces. They employ continuous mechanized production, there has been a universal increase in the depth of extraction and geological structures are becoming increasingly complex. They now focus on comprehensive utilization and environmental protection, and high requirements are placed on geological conditions. Furthermore, selection of the type of coal extraction machinery is decided entirely by the characteristics, thickness, structure, branching, thinning, frequency, and degree of wave-like uplifts, washout, and other facets of the coal seam. The increased depth of extraction has made rock coal and gas prominent and increased the number of occurrences of geothermal water, underground rumblings, water eruptions, blast pressures and other problems. In addition, soil, water and environmental protection, and dust prevention safeguards are becoming increasingly strict. Since the 1970's, some countries have made exploration grids more dense and given attention to rock core and scanning analysis. They have increased the stages of development and exploration, imported a great deal of advanced geophysical exploration technologies, done intensive research on sedimentary structures in coal systems and other things, primarily to determine the geological conditions of extraction.

#### IV. Pay Attention to Coal-produced Gas, Especially to Fact-finding Studies on Coal Seam Gas Resources

Many countries have gained rich experience in this area. China has rich coal resources and many eras of coal formation, coal seams of great thickness, coal basins covering large areas and the parent material for gas generation. While carrying out geological exploration of coal fields, we also should strengthen research on coal-produced gas. It is best if exploration teams with the proper conditions are matched up with the necessary exploration equipment and testing measures to carry out surveys on coal-produced gas and coal seam gas. We should not simply be restrictive and stipulate that geological exploration teams in coal fields should only do surveys on coal seam gas, but instead should include coal-produced gas within the scope of special surveys by petroleum exploration teams.

#### V. Be Conscientious in Carrying Out Work To Compile Exploration Designs and Geological Reports

Exploration design is an important foundation of operations by geological prospecting teams. Compilation of good prospecting plans requires good work in the following areas:

1. Be comprehensive in collecting and meticulous in analyzing the related geological data and go on-site to integrate with actual survey research.
2. Be clear about the intentions of higher authorities and listen to the opinions of mine design, construction and production departments. Give earnest consideration to geological questions and the related economic and technical policy requirements, determine geological tasks and clearly understand the goals of exploration.
3. Based on the characteristics of the exploration region or the geological structures of mines, the degree of stability of primary coal seams, exploration categories decided upon in similar cases and rational deployment of exploration projects, select effective exploration measures and technical methods.
4. After gaining a good grasp of geological data concerning the region of exploration or mine site and the intentions of higher authorities as well as of design and production departments, we should adopt the work method of single-item analysis, comprehensive research, differential treatment and unified deployments to formulate outline requirements according to exploration designs, compare many different programs and select the form to use.

Geological reports are the result of geological research during all stages of exploration and they should be compiled conscientiously by means of adequate guarantees of technical forces and time. Charts and tables should not be overly complex, nor too simple. After transforming and deriving the tens of thousands of values for each basic type of data by "eliminating the imprecise and retaining the precise, eliminating the false and retaining the true, proceeding from one to the next and deriving tables and causes," we should achieve succinct descriptions, emphasize key points, provide sufficient foundations, make clear summaries, have complete charts and tables, and provide reliable data.

12539

CSO: 4013/161

## COAL

### BRIEFS

HEBEI OVERFULFILLS PLAN--As of 30 September, local collieries of the province had produced 14.57 million tons of raw coal, overfulfilling the annual state assigned plan by 70,000 tons 94 days ahead of schedule, and showing an increase of 16 percent over the corresponding period of last year. [Text] [Shijiazhuang HEBEI RIBAO in Chinese 9 Oct 85 p 1 SK] /8918

SHANXI OUTPUT FIGURES--Shanxi's coal output in 1984 was 54.6 percent higher than in 1980, having risen at an average annual rate of 11.5 percent. The province fulfilled ahead of schedule the coal output target for the Sixth Five-Year Plan. Coal output in the first 9 months of this year was 157.3 million tons, representing 86.2 percent of the year's target. During the Sixth Five-Year Plan, the degree of mechanization in the province's coal extraction reached 67 percent, and 55 old mines were modified or expanded, a move which raised output by 12.7 million tons. [Summary] [Taiyuan Shanxi Provincial Service in Mandarin 2300 GMT 23 Oct 85 HK] /8918

HENAN ANTHRACITE MINE--Zhengzhou, 3 Nov (XINHUA)--A coal mine with an annual capacity of 900,000 tons is being built in the Yongcheng coal field, one of China's six bases of anthracite coal in Henan Province. Construction began 1 November. The mine is being built jointly by Henan and Jiangsu provinces and will have seven pairs of shafts upon completion. Jiangsu is a province that is developed economically but short of energy resources. Some 3.1 billion tons of anthracite coal and natural coke have been verified in the Yongcheng coal field. [Text] [Beijing XINHUA in English 1445 GMT 3 Nov 85] /9871

NEW JILIN COAL FIELD--After discovering the large coal field at Yancaogou in Jiutai County, Jilin Province, the First Geological Prospecting Institute of the provincial Geological and Mining Bureau has further discovered a new area with coal deposits around Liutai and Lujia villages in Jiutai County. Judging from the extent of the discovered coal layers, the area may comprise five townships. /Text/ /Changchun JILIN RIBAO in Chinese 14 Sep 85 p 1 SK/ 12228

COAL SHIPPED FROM SHAANXI--Xian, 24 Oct (XINHUA)--Major dredging work has opened up a section of the Huang He in Shaanxi Province to coal ships, a local official said here today. Many billions of tons of high-quality coal reserves have been discovered in Shenmu and Fugu counties in Northern Shaanxi, where no railways and few roads exist. Provincial authorities have spent more than 2 million yuan over the past few years on dredging a 535-km section of the Huang He so that the coal can be shipped out to other areas. The section is the narrowest along the middle reaches of China's second-longest river. Forty shipping specialists recently inspected the river section aboard a 150-seat passenger ship, the largest ever to navigate it. They agreed that it could now be used by 300-ton vessels. They added that the dredging would also aid the exploitation of other natural resources and the development of tourism. China's coal reserves of 781.5 billion tons are second only to the United States. About 70 percent of the country's energy needs are met by coal. /Text/ /Beijing XINHUA in English 1106 GMT 24 Oct 85 OW/ 12228

HENAN OVERFULFILLS QUOTA--In the period of Sixth Five-Year Plan, Henan Province has scored very great achievements in its coal industry. Output of raw coal in 1983 exceeded 60 million tons. The province attained the quota stipulated by the Sixth Five-Year Plan, 2 years ahead of schedule. Output of coal in the first 10 months of this year was some 62 million tons. With the rapid increase in output of coal, the needs of industrial and agricultural production and people's livelihood can be basically satisfied. Output of coal has increased by 4.8 percent a year. The number of township and town coal mines throughout the province now is nearly 3,000 and their output accounts for about one-fourth of the province's total coal output. [Summary] [Zhengzhou Henan Provincial Service in Mandarin 1030 GMT 17 Nov 85 HK] /8309

HUOLINHE STRIP MINE EXPANSION--With the approval of the Ministry of Coal Industry, the south opencut colliery of the Huolinhe Coal Mine will be further expanded, thus enabling the annual production capacity to increase from 3 million tons to 10 million tons. The Huolinhe Coal Mine is one of China's five opencut collieries built during the Sixth Five-Year Plan period. The total area of the coalfield is 540 square kilometers, and it has total reserves of 12.9 billion tons of quality brown coal, which is the best fuel for thermopower generation. By the end of the century this coal mine will become a coal base with an annual production capacity of 50 million tons. The south opencut colliery was built and put into operation in September 1984 in the first-phase construction of the Huolinhe coal mining area. [Summary] [Hohhot Nei Monggol Regional Service in Mandarin 1100 GMT 12 Nov 85 SK] /8309

CSO: 4013/25

OIL AND GAS

REFORM SPURS DAQING'S DEVELOPMENT

OW311240 Beijing XINHUA Domestic Service in Chinese 0026 GMT 29 Oct 85

[By correspondent Zhou Zhongxue]

[Excerpts] Harbin, 29 Oct (XINHUA)--Reform has brought vigor to Daqing oil field, China's largest oil industrial base. During the Sixth Five-Year Plan period, this field has not only overfulfilled the state plan year after year, but has also made good preparations for scaling new heights in the Seventh Five-Year Plan period.

--Crude oil output has increased yearly. In 1980, Daqing's crude oil output was 51.5 million metric tons. By 1984, the output had increased to 53.56 million metric tons. It is estimated that this year will see 55 million metric tons.

--Proven oil deposits have continually increased. From 1981 to the end of 1984, Daqing accumulatively expanded the oil-bearing area by more than 420 square kilometers. Since the beginning of this year, it has discovered new oil-bearing and gas-bearing formations in four areas on its periphery.

--Profits delivered to the state have increased daily. During the Sixth Five-Year Plan period, Daqing was able to deliver profits to the state totaling more than 17.2 billion yuan, and averaging more than 3.4 billion yuan per annum. During these 5 years, Daqing exported crude oil, naphtha, and other products and earned foreign exchange totaling U.S. \$12.3 billion for the state.

--Living conditions of the staff members and workers have markedly improved. From 1980 to 1984, incomes of Daqing Oilfield workers increased by 40 per cent.

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CSO: 4013/19

## OIL AND GAS

### DAQING BUILDS THIRD UNDERGROUND GAS STORAGE FACILITY

Harbin HEILONGJIANG RIBAO in Chinese 2 Sep 85 p 1

[Article: "Daqing Oil Field Completes Gas Storage Facility 1,000 Meters Underground"]

[Text] The number of constantly burning "flares" across the 100-li-wide Daqing oil field has dropped continuously in the past decade. Where has the natural gas gone that was the source of these "flares?" It is now being stored in underground gas facilities in strata 1,000 meters deep.

Underground gas reserve storage can be effective in regulating the imbalances in winter and summer gas usage by storing it during the summer and drawing it out in the winter. It also can conserve energy, which is equivalent to pulling 1 yuan after another out of the constantly burning "flares."

The Daqing Oil Field Natural Gas Company is now building its third gas reserve facility. Two such facilities have been completed. One of them has been in operation for 10 years and has a gas reserve capacity of 38 million cubic meters. The other now has entered the testing and gas monitoring stage and will have a gas reserve storage capacity of 1.5 billion cubic meters. The Daqing oil field was the first in China to build underground gas storage facilities and is the only oil field in China to have these facilities.

Daqing oil field began studying and designing underground gas storage in 1973 and the first facility went into formal operation in 1975. It used exhausted underground gas strata with strong entrapment conditions on all sides. Safer and more economical than surface structures, these facilities also permit the regulation of natural gas production and marketing, avoiding burn-offs in summer when little gas is used. According to statistics, the first completed gas reserve facility has stored a total of 88.9 million cubic meters of gas and drawn out 82.8 billion cubic meters.

12539

CSO: 4013/4

## OIL AND GAS

### SHANDONG BEGINS DOUBLE PIPELINE PROJECT TO MEET HIGHER OUTPUT

HK211405 Beijing ZHONGGUO XINWEN SHE in Chinese 1501 GMT 18 Oct 85

[Text] Jinan, 18 Oct (ZHONGGUO XINWEN SHE)--The construction of a double oil pipeline project involving a 280-million-yuan investment by the state started this morning.

This oil pipeline, with a total length of 246 kilometers, will stretch from Dongying City in Shengli oil field in the west to Huangdao oil terminal in the east. The whole project is to be built with equipment imported from Japan, all of the most advanced technological standard of the 1980's. The pipeline, passing through 3 cities and 13 counties and districts in the central Shandong and eastern Jiaozhou areas, will become the eighth longest oil pipeline in Shandong Province, with a total length of over 200 kilometers.

Shengli Oil Field's daily crude oil output has exceeded 80,000 tons this year and is expected to exceed 90,000 tons next year. As the crude oil output has been increasing rapidly, the existing Dongying-Huangdao single pipeline, with an annual capacity of only 10 million tons, can no longer meet the need arising from the increase in crude oil output. It is reported that this new double-pipeline project, with a designed annual capacity of 20 million tons, is to be completed and put into use by 1 July next year.

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CSO: 4013/19

## OIL AND GAS

### LIAOHE CRUDE OUTPUT UNAFFECTED BY TYPHOON

Shenyang LIAONING RIBAO in Chinese 24 Aug 85 p 1

[Article: "Crude Oil Output at Liaohe Oil Field Stable; 80,000 Employees Fighting Flood To Maintain Production"]

[Text] The Liaohe oil field recently suffered flooding from the Hun He, Taizi He, and Shuangtai He. By 21 August, 119 oil wells, seven drilling teams and three oil transmission stations had been inundated and north-south communications were cut. The 80,000 employees of the oil field were fighting the flood heroically, striving to protect the oil field while maintaining production. Average daily crude oil output during the middle of August increased to 24,800 tons, up from the figure of 24,500 tons during the first of the month.

The Ciyutuo oil recovery plant had 46 oil wells under water after being hit by the first flood peak on 6 August. They organized an emergency team to save heavy electrical machinery at 26 oil wells and worked to move the equipment out of the floodwaters piece by piece. After the water level had dropped, they again organized quickly to restore production and increased daily crude oil output from 2,200 tons to 2,502 tons.

On the evening of 19 August, the effects of a grade-nine typhoon were being felt and a fierce wind and storm swept across the entire oil field. Trees were toppled in many locations and power line poles were leaning. Despite this, the workers drilling wells here continued to brave the rain. The drills turned steadily and oil recovery workers arrived at the wells on schedule. A flood prevention army organized of cadres and workers fought determinedly to strengthen dikes and strive to protect the oil field. On that day, 3,522 meters of wells were drilled in the oil field and it produced 24,790 tons of oil and supplied more than 2 million cubic meters of natural gas to the outside.

The second flood peak on the Liao He now is approaching and the dangerous situation at the Liaohe oil field continues to develop. More than 20,000 employees in the Xinglongtai region are working to protect the dikes and dams.

The 80,000 employees of the oil field are sternly awaiting it and maintaining their vigilance in fighting the flood to protect the field and striving for increased output.

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CSO: 4013/4

## OIL AND GAS

### BRIGHT PROSPECTS FOR HAINAN'S PETROLEUM EXPLOITATION

Haikou HAINAN RIBAO in Chinese 23 Jul 85 p 2

[Article by Li Fu [2521 4395], Engineer, Hainan Geology and Mineral Resources Bureau]

[Text] Petroleum geology survey work in Hainan (including the ocean) began during the early 1960's, when the Regional Survey Team of the former Guangdong Geology Bureau made a geological survey of the landmass, and in 1963 when the Aerial Geophysical Prospecting and Measurement Brigade of the former Ministry of Geology undertook 1:1,000,000 aeromagnetic measurements in the Leiqiong Basin. This provided primary data for development of comprehensive geological surveys and prospecting work in the region. In the early 1970's, the Second Marine Geology Team of the State Geology Bureau undertook a 1:500,000 geophysical survey of Beibu Wan and provided the basic contours of structures of the region as well as an evaluation of the prospects for oil and gas. Beginning in 1974, the Nanhai Petroleum Exploration Guidance Department developed deep-well exploratory drilling for petroleum in the Beibu Wan and Yinggehai regions. Industrial oil and gas flows were discovered and several deep wells also were drilled in the Qiongbai Basin, where industrial oil flows were discovered. Moreover, the Fushan depression was delineated, which provided data for the next step in petroleum exploration.

Hainan Island is part of the Hainan uplift in the Nanhua depression in the Huaxia fault-block region. For a long period, intense crustal movements have formed structural systems with a east-west and north-south orientation as well as a large number of structural shapes. There were multiple periods of structural development that are manifested in different forms. Caledonian and Indo-Sinian activity primarily involved folding and the associated fracturing activity, which caused the strata to assume a belt-like distribution with a northwest orientation. Yanshan movement mainly involved intense fracturing with a large amount of acidic magma intrusion and eruption. It is bounded by the Wangwu--Dingan fracture and there was intense uplifting of the southern part of the fracture, which formed an ancient landmass, and intense subsidence in the northern part, which formed the Qiongbai Basin. Xishan activity mainly involved sustained fault-block activity and associated eruptions of basic magma.

The Hainan uplift formed a dome-shaped terrain with a high center and low perimeter, which subjected this ancient landmass to a long period of erosion and denudation. Mesozoic magmatic rock is distributed over an area of about 17,000 square kilometers, equal to 49 percent of the area of Hainan Island. Although there are shale and carbonatite oil-generating strata within middle **Paleozoic strata**, they occur over an area of only 6,700 square kilometers, equal to just 20 percent of the island's area. Moreover, it was subjected to long periods of magma activity and structural activity that caused rather intense metamorphosis and destruction. It is an unconventional island, with belted zones surrounded by magma. An examination of the geological conditions of oil generation, oil reservoiring, capping strata and preservation indicates that it would have been difficult for oil and gas pools to have formed the ancient landmass in the south.

The Qiongbai Basin is a continental margin offshore fault-subsidence basin formed during the later period of Yanshan movement. The basement is mainly Cretaceous era strata, and fractures have developed. Although these areas now are continental, in the past they were part of an enormous sea that was rich in suspended organisms. The secondary structure in the basin, the Fushan depression, has a triangular shape that begins at Changliu in the east and extends west to Lingao, and it extends from Dengmai in the south into the Qiongzhou sea floor in the north, covering an area of more than 2,000 square kilometers. The Baolian region lies in the center and there are enormously thick accumulations of Tertiary strata that reach a thickness of more than 4,000 meters. The middle segment of the dark colored Eocene rock group, which is mudstone interbedded with oil shale, and the middle segment of the Miocene, which is marl, are oil-generating rock rich in organic matter. They are several hundred meters thick and buried at depths up to 1,000 meters. The sandstone upper and lower segments and the fissured mudstone middle segment of the Eocene, the Oligocene sandstone and the sandstone of the upper and lower segments of the Miocene are excellent reservoiring strata that are several hundred meters thick. The mudstone middle segment of the Oligocene and the mudstone of the Miocene and Pliocene are excellent capping strata over 1,000 meters thick. These form a normal oil pool combination of oil that is generated and reservoir in the same rock. Maturity was reached beginning with the time of oil generation and the depth of burial as well as conversion temperature and pressure. Preservation conditions after the oil was generated also were excellent. Fracturing activity after the Pliocene was very weak and, although basic magma eruptions occurred in the northwest-oriented fractures, the period of volcanic eruptions was short. After the eruptions had stopped, the volcanic vent was blocked, so the destructive effects of volcanic eruptions on oil reservoirs was not great. Geological surveys have been carried out in this area and deep wells have been drilled. Some of the wells have hit petroleum and it is being used to power tractors.

Hainan Island is surrounded by ocean on four sides. It has excellent geological conditions for oil generation and prospects for finding oil and gas. This is especially true of the Beibu Wan Basin and the Yinggehai Basin on the continental shelf, which have quite a few secondary structural depressions. Besides the middle Paleozoic strata, it also accumulated marine facies strata several thousand meters deep with good prospects for finding

oil and gas. Geological surveys show that the Wushi, Maichen and Haitoubel secondary structures lie in an area of the Beibu Wan Basin that is within 100 kilometers of Hainan Island. Industrial oil flows have been discovered during drilling of exploratory deep wells, and there are rather good prospects for finding oil and gas.

We can begin by exploration and development of petroleum on the continent and then develop toward the sea. This has advantages for us because petroleum exploration and development is much easier on land than in the ocean. An examination of the geological conditions of oil generation, oil reservoiring, protection and capping strata on land indicates that the Fushan depression is the site of the best generation and protection of oil and gas pools. We feel that we have bright prospects for petroleum development.

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CSO: 4013/186

## OIL AND GAS

### BOHAI BAY VENTURE WITH JAPAN

OW311738 Beijing XINHUA in English 1538 GMT 31 Oct 85

[Text] Tianjin, 31 Oct (XINHUA)--One of China's most promising offshore oil-bearing structures will soon be opened up in Bohai Bay, according to a recent meeting held here.

At the Sino-Japanese joint work meeting, Chinese and Japanese experts studied exploitation, reserves, and investment as regards the Bz28-1 structure in a zone co-prospected by China and Japan since 1980.

The first producing well will be drilled by the end of this year, according to Akira Matsuzawa, deputy head of the Japan-China Oil Development Corporation.

The structure will become the second offshore oil field jointly developed by China and Japan in Bohai Bay. The first was the Chengbei oil field.

On this structure, the first exploratory well indicated two thick oil-bearing strata, yielding a daily testing output of 7,000 bbl.

Another eight prospecting wells outlined the formation of the structure.

A platform for developing the oil field is under construction in a plant near Bohai.

Akira Matsuzawa said that another structure, named Bz34-2, is under appraisal. He estimated that this structure will go into production a year later than the Bz28-1 structure.

He said nine more exploratory wells will be sunk before the expiration of the contract for joint prospecting in June 1987.

The Japanese geologist, who has been to China 45 times since the 1940's, is confident that four more oil fields will be opened up in the near future.

Meanwhile, the Bohai Petroleum Corporation of China has recently earmarked 900,000 U.S. dollars to train technical workers.

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CSO: 4010/9

## OIL AND GAS

### NEWLY DISCOVERED RESERVES ENHANCE PROSPECTS FOR KARAMAY

Nanjing **XINHUA** RIBAO in Chinese 25 Sep 85 p 3

[Article: "Broad Prospects for Development of Karamay Oil Field--New Oil Pools Discovered in Past 4 Years Have Geological Reserves 1.7 Times Those of Former Proven Reserves"]

[Text] The Karamay Oil Field, which is the same age as the Xinjiang Uygur Autonomous Region, has seen 30 years of development. Not only has crude oil output climbed year after year, but new oil pools with geological reserves equivalent to 1.7 times the original proven reserves have been found at Karamay in the last 4 years. This new prospecting achievement has revealed the prospects for large-scale development of Karamay in the future.

During the summer of 1979, a geological engineer working at the Gu-3 well in Region 8 of the oil field analyzed the strata in already completed exploratory wells. He predicted that oil could be found in the Carboniferous system below them and called for drilling to continue to below 1,000 meters. Very good oil and gas indications were encountered when the drill head reached 1,300 meters and the oil obtained during testing reached a daily output of 177 tons of oil. The oil flow from the Gu-3 well destroyed the theory that many people had held for years which held that Carboniferous strata were incapable of generating or reservoiring oil, and it shook the entire oil field. In 1983, the Oil Field Exploration and Development Research Academy made a comprehensive analysis of the situation at places where oil had flowed from the Carboniferous system and suggested a formal exploration program. Exploration work in part of the region was begun formally in early 1984. The proven reserves that have been discovered up to now in the Carboniferous system are equivalent to one-half of the total reserves in the old oil field.

The upper part of Karamay is young Jurassic and Cretaceous system strata. Very viscous dense oil (heavy oil) was discovered 300 to 400 meters from the surface during development of the Karamay Oil Field in the 1950's. The importation of advanced technologies and equipment in recent years has permitted the organization of technical forces in the Karamay Oil Field to develop exploration for oil pools in the upper parts. After a 20-year effort, an area 300 kilometers long by 30 kilometers wide that contains pools of dense oil has been discovered that starts at Chepaizi in the west and extends north to Xazgat. The dense oil resources are larger than the reserves proven over the past 30 years in the Karamay Oil Field. Experimental heat extraction of the dense oil now has succeeded. The first part of a refining project that will process 200,000 tons of the dense oil yearly has begun and it may be completed and go into operation before the end of the year.

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CSO: 4013/15

PETROLEUM, GEOLOGICAL PROSPECTING IN TARIM BASIN

Nanjing XINHUA RIBAO in Chinese 27 Sep 85 p 3

[Article: "Large-scale Petroleum Geology Exploration Underway in Tarim Basin"]

[Text] Large-scale petroleum geology exploration work now is underway in the ancient Tarim Basin. The reporters [submitting this article] travelled around Tarim and saw unprecedented exploration on a very large scale, the investment of a large amount of effort, the newness of the equipment adopted and rapid progress in construction.

There are nearly 10,000 geological personnel and over 10 geophysical prospecting and large-scale well drilling teams between the ancient Silk Road at the boundary of the basin and the sea of sand near the ruins of an ancient Han and Tang dynasty city. They are revealing the secrets of Tarim and laying out the battlefield for its treasures. They include a large area prospecting survey, concentrated forces for key exploratory drilling in some local regions, and development and construction of new oil fields. A flourishing vitality now has burst from the ancient roads and cities during the new period of construction.

Several thousand prospecting team members from the north, east, south-central, southwest, South China Sea and other areas have gathered like clouds on the 200-plus kilometer Gobi at the northern margin of Tarim. They came to Tarim during the winter of 1984 and the spring of this year, braving the cold from north of the Great Wall, following the high output oil and gas flow that gushed from the Shacan-2 well [Xayar parameter well No. 2] during September 1984. They now are distributed across the ancient and barren Gobi, the drilling towers standing one after the other, trucks passing back and forth, the sounds of machinery and explosives continuing day and night.

The reporter took a look at the desert seismic exploration team that includes experts from the United States in the belly of the large Taklimakan Desert. He saw one after another of the special desert trucks braving the 70 degree [C]-plus temperatures during the peak of the summer driving into the boundless desert. Team members wearing red safety clothing climbed continuously over and down the dunes that were several dozen meters tall. After the explosions that occurred during seismic [testing] had sounded, the data from the seismic waves reflected by the underground strata and structures 10,000 meters below were transmitted to new types of digital seismographs.

Petroleum geology exploration at Tarim was undertaken on a large scale following the strategic decision of the CPC Central Committee to develop Xinjiang and the vast northwest. Updated prospecting measures and strengthened exploration forces already have led to a series of achievements. All of the experts feel that the 560,000-square-kilometer Tarim Basin contains three large uplifts, four large downwarps and five oil generating rock systems and that it has excellent prospects for oil and gas reserves.

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## OIL AND GAS

### BRIEFS

NEW LIAONING REFINERY--The construction of an oil catalytic and cracking unit, one of the key state oil refining projects during the Seventh Five-Year Plan period, was initiated in the No 1 Petroleum Plant in Fushun, Liaoning Province, on 5 October. The annual capacity of this equipment is 1.2 million tons of oil, and the investment is some 79 million yuan. The construction period of this project will be 3 years. After being put into operation, this equipment will help create 130 million yuan of profits and taxes for the state. [Summary] [Shenyang LIAONING RIBAO in Chinese 8 Oct 85 p 1 SK] /8918

SHENGLI INCREASES OUTPUT--Jinan, 18 Oct (ZHONGGUO XINWEN SHE)--Shengli Oil Field announced today that from January to September this year its crude oil output totaled 20.18 million tons, an increase of 23.6 percent over the same period last year. Shengli Oil Field is now striving to become China's second Daqing Oil Field. From January to September, the oil field's drilling footage totaled 2.97 million meters, a total of 800 new wells were put into operation, and the oil field's crude oil production capacity was raised by 2.42 million tons. [Text] [Beijing ZHONGGUO XINWEN SHE in Chinese 1458 GMT 18 Oct 85 HK] /8918

MAOMING EXPORT BASE--Maoming City in south China's Guangdong Province has become an important oil products export base. It sold some 760,000 tons of motor oil, engine oil, heavy oil, paraffin wax, and other oil products in 1984, and this figure was boosted to 393,000 tons in the first 7 months of this year. The city can manufacture 66 kinds of oil products, and 19 of them are sold to over 20 countries and regions including the United States, Japan, and Hong Kong. The city's oil industry was founded in the early 1960s but developed rapidly over the past few years as advanced equipment was imported to improve the quality of its products. [Text] [Beijing XINHUA in English 1839 GMT 9 Oct 85] /9871

OFFSHORE WEATHER SERVICE--A meteorological service center was set up at the Nanhai Western Petroleum Corporation last week to serve the South China Sea operations of oil prospectors. The Zhangjiang-based center, manned by six senior engineers and weathermen, will provide weather forecasts and hydro-meteorological information to offshore rigs and ships. It was set up jointly by the corporation and the Beijing Meteorological Center. [Text] [Beijing XINHUA in English 1838 GMT 29 Oct 85] /9871

CONTRACT FOR OIL SEARCH AWARDED--Beijing, 8 October (XINHUA)--A consortium led by Idemitsu Oil Development Company Limited of Japan was given an additional area of 1,280 square kilometers to search for oil in the Beibu Gulf on the South China Sea, the China National Offshore Oil Corporation (CNOOC) announced here today. The consortium is made up of the Idemitsu China Oil Development Company Limited of Japan, Cluff Oil P.L.C. of Britain, and the Reading and Bates Far East Petroleum Co. of the United States. In September 1983, the Idemitsu-led consortium won the right to search for oil in an area covering 963 square kilometers in the Beibu Gulf. So far, it has made no commercial discoveries after drilling three wells. Located to the west of the Leizhou peninsula in Guangdong Province, the Beibu Gulf covers an area of about 19,000 square kilometers. In the past few years, 21 wells were drilled in the gulf and nine of them reported oil-gas flows with two pumping out over 7,300 bbl a day. [Text] [Beijing XINHUA in English 1053 GMT 8 Oct 85 OW]

BOHAI WELL INCREASES PRODUCTION--Tianjin, 20 Nov (XINHUA)--A well producing about 1,800 bbl of fine quality of oil and 350,000 cubic meters of natural gas a day has been sunk in Liaodong Bay in the Bohai Sea, according to the Bohai Petroleum Corporation. Toward the end of 1984, the corporation drilled a well with a daily oil flow of 7,000 bbl. The corporation began to develop the offshore oilfield, which covers a surface of 20,000 sq km, in 1979. Prospecting shows some 30 promising geostructures there. Two rigs, manufactured by the Dalian shipyard, are now working in the oilfield. The corporation plans to develop several wells annually in the next 5 years. Efforts will be concentrated on two easily exploited geostructures by the end of the 1980s. [Text] [Beijing XINHUA in English 0652 GMT 20 Nov 85 OW] /6662

HUBEI OIL REFINERY DEVELOPS--Since its establishment in 1970, Jingmen oil refinery in Hubei Province has constantly developed production and markedly raised its economic results. The total amount of crude oil processed by the end of October this year was some 25 million tons. Output of gas, kerosene, diesel oil, and other petrochemical products was some 20 billion tons. The total output value was some 2 billion yuan. The amount of profits and tax submitted to the state reached some 1.75 billion, which accounted for four times the state total investment in this plant. [Summary] [Wuhan Hubei Provincial Service in Mandarin 1100 GMT 15 Nov 85 HK] 12228

NEW BEIBU WELL--Guangzhou, 17 Oct (XINHUA)--An exploratory well recently drilled in the Beibu Gulf, off the coast of south China's Guangdong Province, by a Chinese team is producing more than 740 bbl of oil a day, according to the Nanhai (South China Sea) Western Petroleum Corp. Located in the 22 square km Wushi 16-1 oil field, the well proves that three oil layers in the region have industrial production value, an official of the corporation said. This is the fifth well the corporation has drilled in the area since 1981; four of them each produce up to 4,000 bbl of oil a day. The corporation plans to go into commercial operation, zone by zone, from 1987. Some other oil fields in the Beibu Gulf are being developed in cooperation with foreign companies. [Text] /Beijing XINHUA in English 0904 GMT 17 Oct 85 OW/ 12228

DAQING RESERVES REVISED UPWARD--Daqing, 12 Nov (XINHUA)--A recent computation of the geological data on the oil reserves in three major oilfields under the Daqing Petroleum Administration Bureau shows that the exploitable reserves are several hundred million metric tons higher than the original estimate. This new estimate has been accepted by a verification group of the National Mineral Deposits Committee. [Summary] [Beijing XINHUA Domestic Service in Chinese 0016 GMT 12 Nov 85 OW] /8309

CSO: 4013/25

## NUCLEAR POWER

### LI PENG ON NUCLEAR POWER IN SEVENTH FIVE-YEAR PLAN

OW041106 Beijing XINHUA in English 1046 GMT 4 Nov 85

[Text] Beijing, 4 Nov (XINHUA)--Vice-Premier Li Peng said today that the Ministry of Nuclear Industry, apart from meeting the needs of national defense, should put its efforts into developing nuclear-generated electricity, thus laying a better foundation for the country's nuclear power development in the next century.

Addressing a meeting here to mark the 30th anniversary of the founding of China's nuclear industry, Li, who is also a member of the Political Bureau of the CPC Central Committee, sent his greetings to the pioneers, leading cadres, engineers, scientists, and workers in the industry on behalf of the Central Committee and the State Council, and praised their contributions to the development of nuclear defense and the establishment of a complete nuclear industrial system over the past 30 years.

He said the nuclear, water resources and electric power and machine-building industry ministries should concentrate their efforts on developing nuclear energy, with the Ministry of Nuclear Industry providing nuclear fuels, designs, and installations.

The Ministry of Nuclear Industry has a solid technical force, Li Peng said. Nuclear technology should be widely used in the national economy and people's lives in such areas as medical services, food preservation, agriculture, and standards.

He urged all workers and scientists in the nuclear industry to produce high-quality, low-priced products for society in a diversified way, provide good maintenance services and offer technical consultancy.

Jiang Xinxiong, minister of nuclear industry, told the meeting that the Seventh Five-Year Plan period (1986-1990) represents a new historic stage in the development of China's nuclear industry. China will complete its first domestically-made nuclear power plant in that period, he said.

He hoped that all workers in his ministry would shift the emphasis of work to national economic construction.

At the meeting, the ministry issued certificates and prizes to 129 advanced units and 207 model workers in recognition of their contributions to the country's nuclear industry.

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## NUCLEAR POWER

### ROLE OF NUCLEAR POWER IN NATION'S POWER STRUCTURE REVIEWED

Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 6 No 6, 20 Jun 85 pp 1-3

[Article by Peng Shilu [1756 1102 4389]: "The Role of Nuclear Power in China's Power Structure"]

[Text] This article describes the role of nuclear power among China's energy resources as it relates to the four modernizations; its main thesis is that nuclear power plant construction, costs, time, and quality must all be rigorously controlled in order to increase the economic benefits derived from nuclear power development and that attention must be focused on a gradual movement from importation to domestic production.

#### Energy Resources, Nuclear Power, Economic Benefits, and Domestic Production

In order to realize China's grand strategic goal of quadrupling gross agricultural and industrial output value by the end of the century, we must start by effective work in the key development areas of energy, transport and communications. In capital construction, expanding and accelerating nuclear power construction appears to be a top-priority matter in quadrupling output. Electric power must lead the way and electric power construction must be given top priority in the power industry's construction.

In the 35 years since the state was founded, China has made great progress in electric power. Its installed generating capacity has already reached 80.22 million kilowatts, 43 times the 1949 figure, and output has reached 377 billion kilowatt-hours, 87 times the 1949 figure. But the supply of nuclear power is still insufficient. Per-capita power use is only 370 kWh a year, far short of the needs of the four modernizations and the people's livelihood. In comparison with the figures for developed countries and areas, such as Norway's 20,000 kWh per year per capita, the United States' 10,000 kWh per year, France's 6,000 kWh per year and Hong Kong's 3000 kWh per year, we are far behind. As the economic restructuring proceeds and deepens, our national economy will begin to take off and the people's standard of living will be raised further, so that by the year 2000, a per-capita consumption of 1000 kWh per year will still be inadequate. Thus the task of electric power construction is an extremely arduous one.

Our country is broad and populous, with rich coal and hydropower resources, but per-capita reserves are not at all rich, and they are nonuniformly distributed. Most of the hydropower resources are in the southwest, and the bulk of coal resources are north of the **Huai He** and south of Yin Shan, chiefly in **Shanxi**, and Inner Mongolia. But the provinces and cities of the economically developed coastal region have large energy requirements, while exploitable hydropower resources are insufficient and coal resources are lacking there so that power generation has suffered congenital limitations. Building nuclear power stations in these areas would be extremely important in alleviating power supply and demand conflicts, decreasing the southward haulage of coal from north China, and promoting further economic development.

Based on China's current energy resources and economic conditions, our general line for electric power development is as follows: Vigorous development of coal-fired electric power in the near term, reliance on hydropower in the long term, some development of nuclear power to compensate deficiencies, and use of other power sources as local conditions permit. Although in the near term nuclear power will only be a compensatory measure and its development can be undertaken only gradually, its prospects are extremely great.

During the Sixth **5-Year Plan** we are scheduled to begin construction of two nuclear power stations: the Qinshan Nuclear Power Plant with an installed capacity of 300,000 kW, and the Guangdong Nuclear Power Plant, with an installed capacity of 1.8 million kW. Work on these power plants was begun in 1984, and they will be completed and commissioned in the late 1980's or early 1990's.

East China is the country's economically most developed region. Both the value of its output and the amount of profits it pays to higher levels account for more than a quarter of the national total. Currently the power grid's installed capacity is over 11 million kW, and it is forecast that it will reach 40 million kW by the year 2000. There are extremely great power shortages, and the construction of a nuclear power plant obviously is sorely needed. The **Sunan** Nuclear Power Plant's site has already been chosen in Changshan, Jiangyue County, Jiangsu Province. Its facilities will be imported from abroad, and it is estimated that two units with 1 million kW capacity each will be completed by 1993.

Feasibility studies on the Dongbei power plant are already under way and a site has already been selected in a coastal area of Liaoning Province. In addition, the coastal provinces of Fujian and Shandong are actively engaged in nuclear power plant feasibility studies and preliminary site selection.

Based on preliminary planning, by the end of the century China will have built nuclear power plants with a total installed capacity of 10 million kW; in other words, as the 1990's begin, we will be building an average of 1 million kW of nuclear power plant capacity a year.

Although China began developing nuclear power rather late, we have the conditions, the confidence, and the ability to make it develop rather more quickly. Between the late 1950's and the end of the 1960's we relied on our own resources to build several experimental reactors, commercial reactors and nuclear submarine reactors, in addition to establishing a rather complete nuclear engineering and science system and training a large contingent of experienced engineering and technical personnel, experts and professors, and we have considerable nuclear-related natural resources. In order to accelerate the development of nuclear power, we have decided to take 1 million kW pressurized-water reactor units as the standard for the near term. This is because pressurized-water reactors have reached standardized commercial status worldwide and have been adopted by many countries, and because they require relatively little investment and are compact, there is already considerable experience in operating them, operating experience has been excellent, and they are safe and reliable. In addition, we have some experience in the design and fabrication of pressurized-water reactors.

In developing nuclear power, we will firmly continue our policy of opening to other countries. We will actively import advanced equipment, advanced technologies and advanced management experience, as well as funds and personnel. By means of cooperative design and cooperative production with other countries, we will gradually reach the point at which our nuclear power equipment can for the most part be domestically produced.

Nuclear power plants are knowledge-intensive, technology-intensive and funds-intensive undertakings, as well as large-scale engineering projects. Their construction must be subject to unified state planning and centralized leadership, with increased cooperation between the various departments, and vigorous efforts made both at the center and in the localities in order for the work to be done effectively.

The main tasks currently facing us are to concentrate the manpower in all relevant areas and actively support the construction of the Qinshan and Guangdong nuclear power plants. We should construct these two nuclear power plants as low-cost, fast, high-quality, benefit-producing facilities. Otherwise nuclear power may not be competitive or viable and the development of nuclear power plants may be hindered. This should be a matter of great concern to us, and we must be successful in our initial undertaking.

For nuclear power plants to produce large economic benefits, three factors must be stringently controlled during the construction period: costs, time, and quality.

Costs. An analysis of world data indicated that the basic construction cost for a 2 X 1 million kW nuclear power plant is about US \$1.5 billion. If the equipment contractor and construction contractor have cost overruns or if incidental costs during construction get out of control so that the basic construction cost is increased to \$1.65 to \$1.8 billion, a loss of between U.S. \$300 to \$600 million will result after project completion. Calculations make it clear that for each increase of U.S. \$100 million in basic costs, total costs increase by U.S. \$200 million and the total cost

of debt repayment increases by U.S. \$500 million. This makes clear the importance of cost control.

**Time Control.** According to general experience worldwide, the construction cycle for two 1 million kW units is about 6.5 years. If, owing to insufficient construction organization, poor management, late deliveries of equipment and materials or poor quality, the construction cycle is lengthened, it can result in an immense loss for the power plant. Calculations indicate that if the construction time is lengthened by a year, total construction costs will be increased by U.S. \$200-300 million, i.e., U.S. \$600,000 to \$800,000 a year, or \$7-9 a second, and total debt repayments will increase by U.S. \$700-900 million. These figures make it clear that time control is even more sensitive and critical than cost control. Time is money. Marx said, "Saving time and allocating time in a planned manner in the various production departments is the first law based on centralized production; it is even the highest law."

The above indicates that modern economies are dynamic and not static and that when considering the economic benefit derived from investments one must allow for the time factor and for the economic value of time during the various stages of the construction process. Management of nuclear power plant investment must be firmly based on the idea of making all investments produce a yield.

**Quality Control.** Quality must be consistently and stringently controlled from the beginning of the project to the end. Design errors, poor technology or lax quality control will make it necessary to shut down the reactor for tests or repairs after operation has begun. If a nuclear power plant does not operate normally after it is completed, the economic losses are immense. The plant will lose U.S. \$2.5 million a day, or U.S. \$30 a second, in addition to a cost of U.S. \$36 million in lost output value from other production departments. Thus quality control is the most critical of the three major factors and the one to which the economic benefits of a nuclear power plant are most sensitive. Therefore we must resolutely prevent loss of control over quality, and make building an excellent-quality, safe and reliable nuclear power plant a top priority. In addition, the quality of operating and maintenance personnel has an extremely great effect on the safe operation of a nuclear power plant. When construction of an electric power plant begins, these people must be given a stringent theoretical and practical training, and must be included in the entire process of installation, adjustment and startup testing, so that they thoroughly understand the design, characteristics, systems, and operating principles of the plant and can operate it skillfully. Once their quality is assured, they must also be motivated in order for the power plant's operating safety to be thoroughly assured.

As described above, the economic benefits derived from a nuclear power plant depend on controlling three major factors. Provided that we are conscientious in negotiating price agreements, strengthen our engineering management of the construction process, and conscientiously and effectively do the work related to the project's rate of progress and project quality, it is possible to entirely avoid loss of control of these three factors.

In addition to power plants with 1-million-kW units, some border areas that lack coal and hydropower resources should also develop suitable medium and small size nuclear power plants. Industrial enterprises that are in cold areas or have large steam requirements may also establish nuclear heat supply plants.

In order to assure full utilization of nuclear fuel, we should accelerate research on fast neutron reactors. In addition to functioning as nuclear power plants for the production of electricity, fast-neutron reactors also can produce heat for industrial use and can be used in desalination.

To summarize, nuclear power is a form of energy with great prospects, and we must intensify scientific research on it, actively develop new reactor designs, new technologies and new processes, and make thorough preparation so as to lay down a solid foundation for further development in the next century.

8480

CSO: 4013/177

## NUCLEAR POWER

### BRIEFS

SUNAN UPDATE--A large nuclear power plant, the Sunan Nuclear Power Plant, will be built in the East China Region to meet the power shortage there. Equipment and technology have already been imported for the construction of the nuclear power plant located in the (Tangshan) area, Jiangyin County, 120 kilometers from Shanghai. After completion, the total output of the nuclear power plant, designed for the installation of two 1-million-kW nuclear generating units, will reach 13.3 billion kWh, equivalent to 18 percent of the total electricity generated by the East China Power Network this year; it will be able to earn over 60 billion yuan in industrial and agricultural output value. [Text]  
[Shanghai City Service in Mandarin 2300 GMT 13 Nov 85] /8309

CSO: 4013/25

## SUPPLEMENTAL SOURCES

### WIND, SOLAR POWER DEVELOPMENT IN NEI MONGGOL

OW121118 Beijing XINHUA in English 0902 GMT 12 Oct 85

[Text] Hohhot, 12 Oct (XINHUA)--More than 10,000 households on the vast grasslands of the Inner Mongolia Autonomous Region are now lit with electricity generated by wind or solar energy, an official of the region's metallurgical machinery office said.

In Abag Banner (County)--China's experimental center for new rural energy-- 26.5 percent of the households use such kinds of electricity. Some herdsmen even use electricity for pumping, erecting fencing, and warming sheep-washing pools.

As a key wind energy development center, Inner Mongolia has a wind potential of 540 million kW, accounting for one-third of the country's total.

Now a wind machinery industry, covering research, design, manufacture and promotion, has taken shape in the region. Eleven kinds of wind equipment have been developed, including generators and pumps.

In the first half of this year, the region turned out 5,000 wind power generators, or 64 percent of China's total.

The generators, with capacities between 50 and 100 watts each, are ideal for pastoral areas.

Up to now, 10,000 wind power generators and wind-driven pumps have been installed in Inner Mongolia.

The region plans to promote wind and solar electricity by 1987 in 14 of its banners, where there is now a shortage of supply.

/9871

CSO: 4010/8

## SUPPLEMENTAL SOURCES

### OFFSHORE ISLAND TO BECOME NEW ENERGY PILOT BASE

OW181627 Beijing XINHUA in English 1500 GMT 18 Oct 85

[Text] Hangzhou, 18 Oct (XINHUA)--China and the European communities will begin developing wind, tidal, and solar energy resources on Dachen Island, off Zhejiang Province, in early 1986.

The communities will spend 4 million U.S. dollars building 12 projects on the island, under an agreement signed with China's State Science and Technology Commission in Brussels last July.

These will include a wind power station, a solar energy power station, a tidal power station and methane gas pits. Total investment will come to 20 million yuan (about 6.7 million U.S. dollars), according to the Provincial Science and Technology Commission.

The 14.6 sq km island, which abounds in wind, tidal, and solar energy resources, is expected to become a new energy pilot base in China in 1990.

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CSO: 4010/8

## SUPPLEMENTAL SOURCES

### ECONOMIC FEASIBILITY OF BIOGAS CONSTRUCTION IN CHINA

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 4, Aug 85 pp 9-12

[Article by Huang Zhijie [7806 1807 2638] of the State Economic Commission and Chinese Academy of Sciences Energy Research Institute: "Analysis of the Economic Feasibility of Biogas Construction in China"]

[Text] Making biogas through anaerobic fermentation of organic matter is not only an important measure for solving the rural fuel shortage but also is an important measure for comprehensive utilization of biological resources, for promoting the joint development of agriculture, forestry, animal husbandry, sideline production and fisheries, for improving the economic results of agriculture, for protecting the ecological environment and for achieving benign cycles in agricultural production. Moreover, it also is an important measure for improving the environment and sanitation in rural areas, for improving the quality of life of rural people and for achieving modernization in rural areas.

The fermentation of organic matter to make biogas requires the construction of methane pits and the associated systems for storing, transmitting and using the gas. The costs of the raw materials that are consumed to build this equipment, the wages of the workers and other factors constitute the investment in biogas production and utilization. The three-integrated methane pits should not include the expenses required to build toilets and **pigsties**, but it should include the cost of improvements to the original toilets and **pigsties that are** required for the collection of manure.

To make it possible for normal biogas production, regular annual operating costs also must be invested. This includes the cost of the manpower and materials that are consumed in the management and maintenance of methane pits.

There are multifaceted benefits from the production and utilization of biogas. They include direct economic benefits, indirect economic benefits and social benefits.

Examples of the direct economic benefits of biogas utilization include the fact that, in comparison with the direct burning of firewood and coal, a certain amount of firewood and coal is conserved, which reduces the costs of fuel. Compared with the use of coal for lighting, biogas used for lighting can reduce the costs of kerosene purchases while improving illumination and raising the

quality of production. Compared with the direct burning of crop straw, the use of organic matter for fermentation of biogas increases the amount of organic fertilizer, which can be sold to production teams and provide greater direct benefits to peasant families.

Many indirect benefits also accrue from the production of biogas. These benefits sometimes play an important role in the development of biogas. For example, the crop straw that is saved can be used as feed to develop livestock. This not only increases incomes from animal husbandry but also provides raw material for making biogas. The peasants can reduce the amount of time they spend each year collecting firewood and use it to develop sideline production and increase their incomes. They can use the residue from fermentation as a feed for raising fish, for cultivating mushrooms, and for raising earthworms as a protein feed for poultry and livestock raising. Methane lights provide improved illumination over oil lights and supply the conditions for the peasants to use the hours of darkness for embroidering, weaving, making clothes and other sideline production. A survey done in Jiangsu Province's Hai'an County showed that many peasant families are calling for the development of biogas for this very reason.

Furthermore, the development of biogas brings social benefits in many areas. For example, the fact that it reduces the direct burning of crop straw means that it can develop animal husbandry and increase the amount of animal protein provided for society. The solution of the peasants' household fuel problems will protect trees and promote the development of forestry. Protection of trees and the increased vegetation can reduce soil erosion and improve the ecological equilibrium. The increased amounts of organic fertilizer can reduce the use of chemical fertilizers, improve the soil, raise yields and other things. An improved environment in rural areas will reduce disease and strengthen physical health. Moreover, regions where biogas is used to generate electricity can improve culture, entertainment, sparetime study and other conditions. Although these benefits are extremely important for all of society, investments in biogas facilities often do not provide direct economic benefits. These benefits, therefore, will not be included in the economic feasibility analysis that follows.

#### I. Economic Analysis of the Use of Simple Methane Pits by Rural Households

Most of the methane pits that have been built in China are 6 to 8 cubic meter ordinary temperature fermentation methane pits that are used mainly to meet the household needs of rural families. Most of the methane pits built in the past are simple methane pits made of clay, lime, sand, bricks and other materials. The raw materials for these methane pits are easily obtained, construction is fairly simple and costs are inexpensive, requiring only 30 to 40 yuan for a single methane pit, but the quality is poor and they are prone to water and gas leaks. Moreover, they have a rather short useful life. Those that are maintained and inspected well can be used for 10 years or more but most can be used for only 5 years or so. If managed and used inappropriately, the useful life is even shorter.

The economic results of simple methane pits are shown in Tables 1 and 2.

Table 1. Calculation of Expenses and Results of Simple Methane Pits\*

(units: yuan)

Year	Expenses calculated for Year	Interest for yr (6% annual rate)	Maintenance costs	Benefits during year	Expenses defrayed to following year
1	40	2.4	5	14.5	32.9
2	32.9	1.97	5	14.5	25.37
3	25.37	1.52	5	14.5	17.39
4	17.39	1.04	5	14.5	8.93
5	8.93	0.54	5	14.5	-0.03

\* For costs recovered within 5 years

Table 2. Calculation of Expenses and Results of Simple Methane Pits\*

(units: yuan)

Year	Expenses calculated for Year	Interest for yr (6% annual rate)	Maintenance costs	Benefits during year	Expenses defrayed to following year
1	40	2.4	5	20.00	27.40
2	27.40	1.64	5	20.00	14.04
3	14.04	0.84	5	20.00	-0.12

\* For costs recovered within 3 years.

The results of the calculations in Tables 1 and 2 show that the economic benefits of these methane pits still are extremely good. In the calculations, the cost of making the biogas is 40 yuan, the interest is calculated at a 6 percent annual rate and the yearly maintenance and inspection costs including materials and labor are 5 yuan. Table 1 calculates on the basis of a 5 year

useful life for the methane pits. The average yearly benefits should be no less than 14.5 yuan if all of the costs are to be recovered during the useful life of the methane pits. If we calculate the cost of crop straw at 0.03 yuan per jin, this would be equivalent to the price of 483 jin, which is equal to the amount of straw used in more than a month by a peasant household. The direct economic benefits provided by conservation of crop straw and of the kerosene used for lighting as well as by the increased amounts of organic fertilizer from a methane pit that operates normally for one and one-half months each year could compensate for all the costs including the interest on the investment within 5 years. If normal operation of a methane pit can be carried out for more than 6 months a year, all of the investments could be recovered within a year.

The amount of economic benefits is related to the program selected for comparison, however. If the material conserved through the use of methane pits is coal instead of straw, and if we calculate the cost of coal at 25 yuan per ton, the 14.5 yuan would be equivalent to the price of 580 jin of coal, which is the amount of coal burned by peasant households over a 4-month period. The methane pits would have to be in normal operation for more than 3 months each year, therefore, and it would take 5 years before the investments could be completely recovered through the conservation of coal and kerosene and increased amounts of organic fertilizer.

Table 2 is calculated on the basis of a 3 year useful life for the methane pits, which means that the average benefits could be no less than 20 yuan per year if the costs are to be completely recovered. If we calculate the cost of grass straw at 0.03 yuan per jin, this would be equivalent to the price of 700 jin of straw. This shows that if the methane pit is able to operate normally for 2 months, the direct economic benefits that accrue would permit recovery of all the costs within a period of 3 years.

## II. Economic Analysis of Cement Methane Pits Used by Rural Households

Simple methane pits require low investments, have poor quality, leak water and gas easily and have a short useful life. Therefore, the use of cement methane pits should be popularized over the next several years. These methane pits are made completely of cement and their inner walls are painted with a coating that prevents gas leaks. The methane pits are of good quality, but the cost of building them is higher, 150 to 200 yuan per unit, and they generally have a useful life of 15 years or more. Table 3 shows the calculations of the economic benefits of this type of methane pit. In the table, the cost of making the biogas is 200 yuan, the interest rate on the investment is 6 percent per year and annual maintenance and inspection costs are 5 yuan. This means that the benefits must average 25.6 yuan per year if the entire cost of the investment and interest are to be recovered within 15 years. In regions where the cost of straw is 0.03 yuan/jin, this would be equal to the price of 853 jin of straw. This shows that if the methane pit can be operated normally for 3 months each year, then the benefits that accrue from the conservation of straw and kerosene and the increased organic fertilizer could make it possible to recover the investments completely within 15 years. If this type of methane pit is kept in normal operation for 8 months out of the year and used for cooking, it could

conserve about 2,600 jin of straw, which would be 78 yuan if we figure at 0.03 yuan per jin. If used for lighting, it could conserve 4 yuan in kerosene costs, which would provide average yearly direct economic benefits of 82 yuan. In this way, as shown in the analysis in Table 4, the cost of investments in methane pits (including interest) can be recovered completely in less than 3 years.

Table 3. Calculation of Expenses and Results of Cement Methane Pits\*

(units: yuan)

Year	Expenses calculated for Year	Interest for yr (6% annual rate)	Maintenance costs	Benefits during year	Expenses defrayed to following year
1	200	12	5	25.6	191.40
2	191.4	11.48	5	25.6	182.28
3	182.28	10.94	5	25.6	172.62
4	172.62	10.36	5	25.6	162.38
5	162.38	9.74	5	25.6	151.52
6	151.52	9.09	5	25.6	140.01
7	140.01	8.40	5	25.6	127.81
8	127.81	7.67	5	25.6	114.88
9	114.88	6.89	5	25.6	101.17
10	101.17	6.07	5	25.6	86.64
11	86.64	5.20	5	25.6	71.24
12	71.24	4.27	5	25.6	54.91
13	54.91	3.29	5	25.6	37.60
14	37.60	2.26	5	25.6	19.26
15	19.26	1.16	5	25.6	-0.18

\* For costs recovered within 15 years.

Table 4. Calculation of Expenses and Results of Cement Methane Pits\*

(units: yuan)

Year	Expenses calculated for year	Interest for year	Maintenance costs	Benefits during year	Expenses defrayed to following year
1	200	12	5	82	135
2	135	8.1	5	82	66.1
3	66.1	3.97	5	82	-6.93

\*Methane pit in normal operation for 8 months each year.

### III. Economic Analysis of Collective Gas Supplies From Methane Pits

Reforms in rural economic systems in China and the rapid development of agriculture and rural and small town industries has led to fast rises in peasant incomes and rapid improvements in living standards. The appearance of various types of specialized households has meant that the methane pits used by peasant households are unable to meet the needs of rural economic development. The fact that some peasant households have not assumed contractual responsibility for land and are not raising pigs or other livestock means that they do not have the raw materials for producing biogas. Some specialized households have concentrated on raising pigs, cattle, poultry and other animals and have a large amount of animal waste that can be used for making biogas. The centralized supply of biogas, therefore, may become a trend in rural household energy use in China.

Although centralized supplies of biogas have many advantages, the investments are much greater than decentralized methane pits. According to already-constructed centralized biogas supplies, each household must invest an average of 300 to 600 yuan, which is one to two times higher than the investments required for decentralized methane pits, so the economic benefits would be much lower. Most centralized biogas supplies at the present time are used to run public welfare activities and are not concerned with economic results. To make it possible for centralized biogas supplies to develop rapidly, they must provide a certain amount of economic benefits. The largest centralized biogas supply station in China to date is the Qianjin State Farm in Chongming County [Shanghai Municipality] which already has built 65 50-cubic-meter methane pits to supply the household needs of the families of 720 state farm employees. An analysis of the economic benefits of this project is provided in Table 5.

Table 5. Analysis of the Economic Benefits of Centralized Biogas Supply Projects\*

(units: 10,000 yuan)

Year	Expen- ses cal- culated for year	Inter- est for year	Main- ten- ance costs	Bene- fits during year	Expen- ses de- frayed to fol- lowing year
1	54.7	3.28	0.66	4	54.64
2	54.64	3.28	0.66	4	54.58

\* Compared with a coal conservation program.

This project required 547,000 yuan in investments and the interest rate on the investments is calculated at 6 percent. The operating costs consist of the

wages of six workers and the costs of equipment maintenance, averaging 6,600 yuan per year. The direct economic benefits per year as a substitute for coal amount to 40,000 yuan. The use of poultry and livestock waste as a raw material for fermentation means that the fertilization benefits are the same before and after fermentation, so the cost of the inputs and the output of benefits from this part may be excluded from the analysis. Calculating in accordance with this standard, Table 5 shows that the economic benefits from coal substitution alone would require 90 years to recover the capital. The equipment would be worthless long before this time.

If this sort of project is used to supply biogas to rural residents, and if we calculate the amount of straw conserved by each household to be 4,000 jin per year (assuming year-round gas supplies) and the cost of straw to be 0.03 yuan per jin, then each household could obtain 120 yuan in economic benefits each year, which would total 86,400 yuan for the 720 households, as shown in Table 6.

Table 6. Analysis of the Economic Benefits of Centralized Biogas Supply Project\*

(units: 10,000 yuan)

Year	Expenses calculated for year	Interest for year	Maintenance costs	Benefits during year	Expenses defrayed to following year
1	54.7	3.28	0.66	8.64	50
2	50	3	0.66	8.64	45.02
3	45.02	2.7	0.66	8.64	39.74
4	39.74	2.38	0.66	8.64	34.14
5	34.14	2.05	0.66	8.64	28.21
6	28.21	1.69	0.66	8.64	21.92
7	21.92	1.32	0.66	8.64	15.26
8	15.26	0.92	0.66	8.64	8.20
9	8.20	0.49	0.66	8.64	0.71
10	0.71	0.04	0.66	8.64	-7.23

\* Compared with a crop straw conservation program.

An analysis of the economic results shown in Table 6 indicates that the entire cost could be recovered in less than 10 years' time. Development of rural centralized biogas supplies is feasible in economic terms. If we make comparisons with coal usage, however, the economic benefits are not very high. There still is a need, therefore, for some effort to reduce the investment costs of centralized biogas supplies, to improve the gas production rate of the equipment and to lower the manufacturing cost of the equipment. Otherwise, the absence of good economic results will mean that it only can be handled as a welfare matter.

#### IV. Economic Analysis of the Use of Methane To Generate Electricity in Rural Areas

China has vast rural areas and the coverage area of large power grids is limited. Nearly half of the peasant households in rural areas have no electricity. In areas reached by power grids, the shortage of electricity supplies has restricted the use of electricity and it still is not possible to guarantee electricity supplies at times. For this reason, the development of small-scale biogas power stations in areas with biogas resources to supply rural areas with electricity is of extremely significant importance for improving cultural levels and living standards in rural areas, for processing grain and feed, for developing rural and small town industries that do not consume much electricity and other areas.

The burning of biogas to generate electricity generally is done by burning the biogas together with diesel. The cost of the diesel consumed per kWh is 0.04 yuan, while the cost of electricity supplied for agricultural production by power grids is only 0.05 yuan, so it appears that there are no benefits. Although there is a large price differential for electricity supplied for residential use, it is used for only 3 to 4 hours each day and the economic results are very low. Therefore, if economic analysis of biogas power stations uses the price of electricity in large power grids as a comparative program, the investments could not be recovered.

If electricity generated with biogas is compared with electricity generated using diesel, the economic benefits can be rather high. A common problem at present in the generation of electricity using biogas in rural areas is a lack of match-up between generator capacity and methane pits. In most cases, only a 20 to 25 cubic meter ordinary temperature fermentation methane pit is matched with each kW in generator capacity, and each kW of generator capacity can generate only 3 to 5 kWh each day on the average. Calculated on the basis of 300 days, only 1,000 to 1,500 kWh of electricity would be generated each year. The utilization time of the equipment is too low, which decreases the economic results. Table 7 is a comparative analysis of the economic results of electricity generation using biogas generators with an 8 kW [capacity], the largest now in use in rural areas, with those from electricity generated with diesel. In the calculations, biogas electricity generation increases methane pits, gas transmission and gas storage, while the other equipment is considered to be the same as for diesel electricity generation. Operational costs are calculated only using the costs of the labor required for material input and output and the costs of maintenance and inspection. The operational and maintenance costs of the generators is considered to be the same as for diesel generators. The benefits calculate only the costs of the diesel saved during power generation.

The results of the calculations show that with an equipment utilization time of 2,000 hours or less [per year], the direct economic benefits of generating electricity with biogas as compared with generation using diesel cannot recover the increased investment costs. If consideration is given to indirect benefits such as power generation to promote the development of industry and sideline production, increased peasant incomes and so on, and to social benefits like the limited supplies of diesel, construction of biogas power stations could provide benefits. From an economic analysis, the utilization of biogas for

power generation should study fermentation techniques with high gas output rates and improvements in the utilization time of power generation equipment.

Table 6. Analysis of the Economic Benefits of Centralized Biogas Supply Projects\*

(units: 10,000 yuan)

Yr	Expenses calculated for year	Interest for year	Maintenance costs	Benefits during year	Expenses defrayed to following year	Notes
1	3000	180	30	70	3140	Based on power generation for 1,000 hours [per year]
1	3000	180	30	105	3105	Based on power generation for 1,500 hours [per year]

## V. Conclusions

1. From an economic analysis, simple methane pits have the best economic results. They require fewer investments, provide results quickly and have a short capital recovery time. They do, however, require a great deal of maintenance and replacement work, are difficult to manage, and cannot be the direction of long-term development.
2. The economic benefits of household concrete methane pits are good and they are the main pattern for extension in rural areas at present. As peasant incomes increase and production becomes specialized, however, they will become increasingly unable to adapt to new situations in rural areas.
3. Centralized biogas supplies are the primary pattern for modernized energy supplies for household use in rural areas. The economic results are low at the present time, however. Research on new fermentation techniques is needed to improve their economic benefits.
4. The direct economic results of electricity generation using biogas under current production conditions are low. Construction is appropriate only in situations where indirect economic benefits are high or where the social benefits are high. Further research is needed on high efficiency gas producing equipment, improving the utilization rates of generating equipment and improving the economic benefits of using biogas to generate electricity before they can become widely used.

12,539/8918  
CSO: 4013/187

## SUPPLEMENTAL SOURCES

### BRIEFS

GANSU SOLAR POWER STATION--Lanzhou, 7 October (XINHUA)--China's first solar energy photo-electricity station began operation today in Yuzhong County in China's northwestern Gansu Province. Financially backed by Japan's Kyoto Ceramic Company, the 10-kW installation is able to provide lighting for 130 rural households and 14 government offices and enterprises. With accumulator cells in the installation, the station can generate electricity for 6 or 7 days in a row in overcast weather. The construction of the station, located in central Gansu, began in late March this year. Gansu now is China's major solar energy research and application base. [Text] [Beijing XINHUA in English 1522 GMT 7 Oct 85 OW]

CSO: 4010/6

## CONSERVATION

### CONSERVATION EFFORT BY INDUSTRY APPLAUDED

Beijing JINGJI RIBAO in Chinese 31 Aug 85 p 1

[Article: "Good Energy Conservation Achievements in Key Industrial Enterprises Nationwide During the First Half of 1985"]

[Text] Key industrial enterprises throughout China adhered to the principle of "combining development with conservation" and achieved good results in energy conservation work during the first half of 1985. Growth in energy consumption was lower than the rate of growth in value of output. The energy conservation rate was 5 percent. According to statistics from the State Statistics Bureau for nearly 3,000 key industrial enterprises under ownership by the whole people, the total value of industrial output during the first half of 1985 grew by 11.1 percent over 1984, while energy resource consumption grew by only 5.2 percent. Some 14 million tons of standard coal were conserved, equivalent to 5.3 percent of total coal consumption in these enterprises over the same period.

A responsible person in the Industrial and Communications Materials Office of the State Statistics Bureau pointed out during a speech on declining energy consumption in key industrial enterprises that energy conservation work in key industrial enterprises during the first half of this year had three characteristics: 1) A universal decrease in energy consumption per unit of product in all industries. Energy consumption per unit of product in high energy-consuming industries like the metallurgical, coal, petroleum, chemical, construction materials and other industries declined by more than 3 percent compared with the same period in 1984. 2) A rapid increase in value of output in low energy-consuming industries and a substantial decrease in energy consumption. In the machine industry, for example, the value of output during the first half of this year was 27.2 percent higher than during the same period in 1984. Total energy consumption declined by 1.8 percent and the amount of energy consumed per yuan in value of output declined by 22.8 percent. The value of output in light industry increased by 11.3 percent while energy consumption increased by only 4.5 percent, and there was a 6.1 percent decrease in energy consumption relative to value of output. 3) The profits and taxes created by consumption of one ton of energy resources exceeded growth in value of output. During the first half of 1985, these enterprises realized total profits of 22.7 billion yuan, up by 12 percent over

the same period in 1984. The profits and taxes created by each ton of energy resources increased from 76.53 yuan in 1984 to 85.76 yuan in 1985, a net increase of 9.23 yuan.

This responsible person also pointed out that, besides the inadequacy of energy conservation work, the main problem was limited achievements in direct energy conservation and insufficient concentration on energy conservation work. Most energy conservation achievements during the first half of 1985 were gained through reliance on indirect energy conservation. There were few that truly depended on technical progress to achieve direct energy conservation. Energy conservation work in electrical power, which has the greatest shortages at present, awaits strengthening. Among 25 energy consumption indices, 15 showed a rise. Unit electricity consumption for cement, calcium carbide, crude oil processing, electricity utilization rates in power plants, ferrosilicon, cotton yarn, chemical wood pulp, mechanical wood pulp and newsprint increased compared with the same period in 1984. These situations show that there still is great potential for energy conservation and that we must continue to focus on energy conservation work.

12539

CS0: 4013/181

## CONSERVATION

### RURAL AREAS LAG BEHIND REST OF NATION IN CONSERVATION

Beijing JINGJI RIBAO in Chinese 31 Aug 85 p 1

[Commentary: "Pay Attention to New Problems in Energy Conservation Work"]

[Summary] Energy conservation work in China has made major achievements for several years in succession and a contribution has been made to guaranteeing sustained growth in the national economy. It must be noted, however, that energy resource supply shortages continue to be a prominent factor restricting economic development and that there still are heavy energy resource tasks. This is especially true during the process of invigorating the economy, when new conditions and new problems appear in energy conservation work and it faces new challenges. This should attract the attention of related regions, departments and enterprises.

The new situation that now has appeared in energy conservation work is that some regions have not dealt well with the contradictions between micro-policies and macro-policies and between immediate benefits and long-term benefits. The phenomenon of irrational utilization and serious waste of energy resources may reappear or continue to develop. It is manifested concretely in the blind pursuit of rapid growth in industrial production. As a result, some regions have striven to develop electrical power generation with high energy consumption by using low efficiency small steam condenser thermal power and diesel engines. Some regions now are importing very uneconomical small internal combustion generators. This has created an ever-growing shortage in energy resource supplies, especially supplies of electrical power. Second, a lack of correct guidance has led to a failure of rural and small town industries in some regions to develop fully into industries that use agricultural products as raw materials and that consume low amounts of energy. Technically backward small blast furnaces, small electrical furnaces and traditional coking with backward equipment have reappeared, and a large number of "coal tigers" and "electricity tigers" have been transferred to rural areas. This has caused energy consumption per unit of product in rural and small town industries to be about one-fifth higher than average levels for all industry in China. Third, future energy conservation will depend increasingly on technical progress and require even more capital. In a situation of strict control on the scale of capital construction, however, there is no way that investments accumulated by the state to arrange for capital construction for

energy conservation can increase substantially. All of these investments have been allocated to local areas, and localities and enterprises often are unwilling to spend these funds on technical transformation for energy conservation.

Some countermeasures as outlined below should be implemented as quickly as possible.

One, we must formulate energy conservation regulations and strengthen energy conservation management. The "National Energy Resource Conservation Management Articles" formulated at the National Energy Conservation Work Conference already have been approved and implemented by the State Council and will become an important step in the orientation of energy conservation work toward laws and regulations.

Two, we must focus on formulation of energy consumption or efficiency standards for primary energy-consuming equipment, instruments and tools. Foremost are the large number of widely-used industrial boilers, industrial kilns, electrically-powered equipment and household appliances. Production and utilization of any that exceed the standards should be restricted. At the same time, we should focus on the compilation of energy conservation design regulations, standards or technical stipulations for projects and on resolute implementation of them.

Three, we must apply various economic measures to motivate fully enthusiasm for energy conservation in all areas. We should issue and perfect all types of energy conservation methods such as preferential supplies of energy resources, enterprise responsibility for energy use, quota accounting of energy conservation, bonuses for conservation and fines for exceeding quotas, and other methods. Moreover, we should strictly implement preferential prices for superior quality mechanical and electrical products, a rational heating price for integrated production of heat and electricity, electricity pricing policies, and so on.

Four, we must support scientific research projects related to technical transformation and application of energy conservation and use state quota subsidies, issuance of preferential loans and other methods to guide localities and enterprises to use their own capital to carry out more energy conservation projects, construction, renewal and transformation. This is especially true of the need to arrange for construction of a group of technologically advanced model projects that have good energy conservation results and economic results as well as significance for universal extension to play a role as demonstrators of technical transformation for energy conservation in all industries.

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CSO: 4013/181

## CONSERVATION

### BRIEFS

1985 CONSERVATION TARGET EXCEEDED--Beijing, 28 Nov (XINHUA)--China's enterprises are expected to save more than 30 million tons of standard coal this year, exceeding the 18-million-ton target for 1985, according to the State Economic Commission. By the end of the Sixth 5-Year Plan (1980-1985), more than 120 million tons of standard coal are expected to have been saved, the commission reported. During the period, energy consumption for every 100 million yuan of industrial output value dropped to 60,000 tons of standard coal, increasing the annual average energy-saving rate to more than 5 percent. /Text/ /Beijing XINHUA in English 0717 GMT 28 Nov 85 OW/ 12228

NEW MIXTURE WILL SAVE GASOLINE--Changsha, 2 Nov (XINHUA)--A mixture of gasoline and water for use as [motor vehicle] fuel passed certification tests in this capital of Hunan Province Friday. Tests showed that the emulsion can be used in temperatures between 45° and 5° below zero. The new mixture can save 10 to 15 percent of gasoline ordinarily used. Prepared by mixing ordinary gasoline with 13.5 percent water and a small amount of additives, the emulsion will not block the carburetor even when the car climbs slopes. Because of full combustion, the ratio of harmful gases in the exhaust is lower than the criterion stipulated by the state. It can be used in all kinds of internal-combustion engines without doing any harm to them, engineers said at the meeting. The emulsion was developed by technicians of the Hengyang Bus Company, Hunan University and the Hunan Petroleum Company after 3 years of research. [Text] [Beijing XINHUA in English 1651 GMT 2 Nov 85 OW] /9274

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